SEPTEMBER 23, 1957

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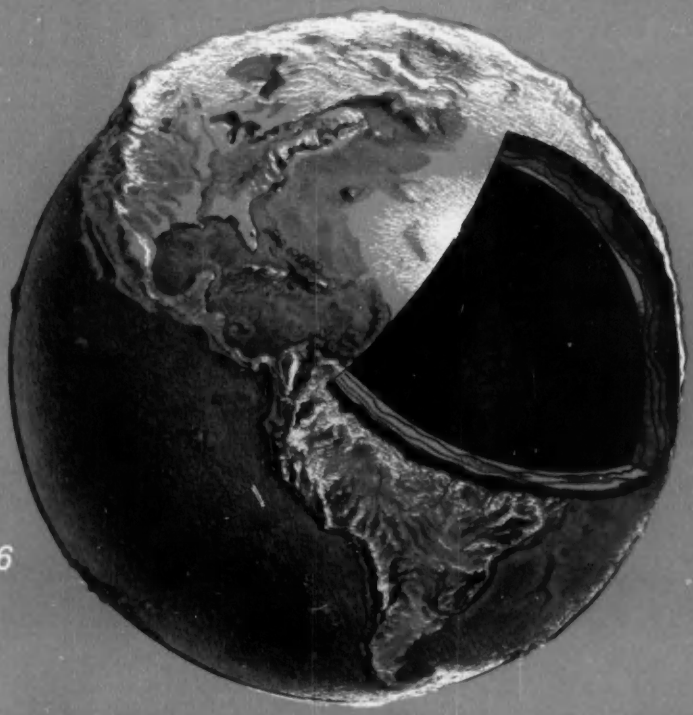
Research AND Development EDITION

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN
RESEARCH AND DEVELOPMENT

Are we running out of metals?

see page 36



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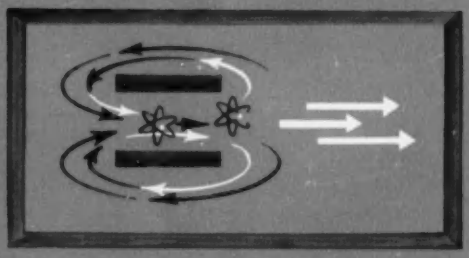

Magneto fluid dynamics to replace heat engines?

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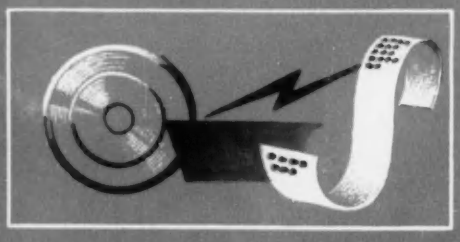

Machine tools spearhead general machine design

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E B POWER GS D 1
UNIVERSITY MICROFILMS IN
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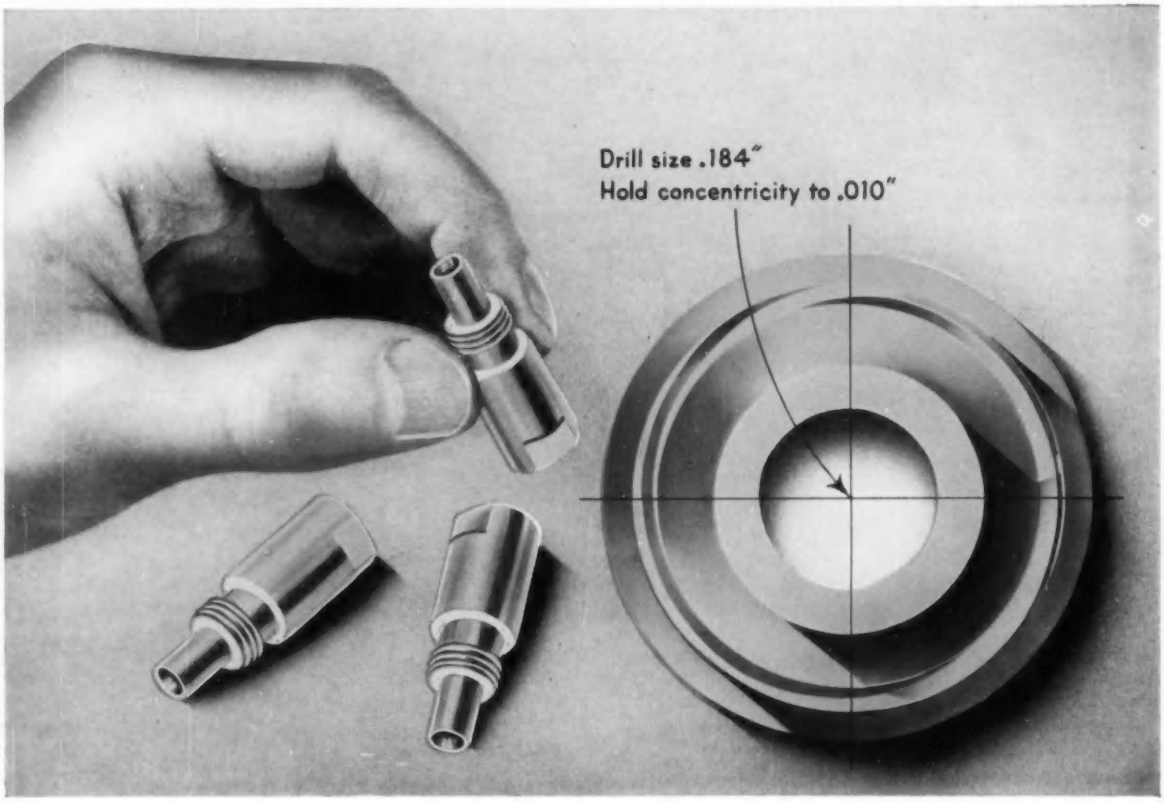
ANN ARBOR MICH

How Anaconda can help you get the exact Rod to fit the job



THE broad line of Anaconda free-cutting copper and copper-alloy rods gives you widest latitude in selecting from warehouse stock the precise rod for most screw machine jobs. But every once in a while there are special requirements.

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With standard free-cutting brass rod the drill had a tendency to wander, running the concentricity off as much as .024". To correct this, The American Brass Company provided rod stock with a minor variation in fabrication for deep drilling. This free-cutting brass rod has a slightly harder core, which minimizes the tendency of the drill to run off center at the high drilling speeds used. Now M. J. Grass holds the concentricity to .008" or under. With regular free-cutting brass, rejects ran as high as 15%. With the deep-drilling rod, there are no rejects.

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When you need special physical characteristics, such as a harder core for deep drilling or additional ductility to permit spinning or cold forming after machining, either the temper, the alloy, or both can be adjusted to meet your requirements.

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Comprehensive data on composition and machinability of standard Anaconda Alloys, standard specifications, weights, and dimensions of standard rods is available in Publication B-3. For this booklet – for special technical assistance – write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 5270

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Research and Development edition

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN RESEARCH AND DEVELOPMENT

September 23, 1957 Vol. 28, No. 11

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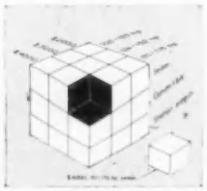

● **Linear programming,** game theory, and now "total think" (see page 35) are all methods (crutches?) designed to help us choose a path among too many alternatives. Management really needs this help. But—extended to personal affairs it might lead to trouble. Can you picture your wife *calculating* the color of her new drapes?

● **Automatic controls** and thinking machines (see page 25) may seen like man's best friend but a tape-controlled milling machine of our acquaintance knew that there was still a big gap between men and machines. Signs were plastered around the shop walls admonishing him to THINK (he couldn't help but), DO IT NOW (he had already finished). But one in a corner kept shorting out his relays. It read SCHEME.

● **In a cubic mile** of ordinary rock, there is enough aluminum to last the US for 2000 years at the present rate of consumption (iron, 600 years). Better recovery methods will make these metals available, but, as indicated on page 36, others will soon be exhausted. Metallurgists are already looking for adequate (and better) substitutes.

● **It's true of editors** and it's true of engineers—the best man is the best teacher. He knows the technique, he knows the procedures, he knows the people to turn to in emergencies, and most important, he knows how to transmit this information to an assistant. We don't intend to argue the engineering-shortage question, but one thing is certain: Good engineers will always be in short supply—and good engineers require good teaching. That's why we were sorely troubled to read the US Office of Education report that today there are only 75,000 science teachers, as against 136,000 in 1950. You can't blame the teachers or even the schools, but the public conscience must be in a sad state. Ours is.

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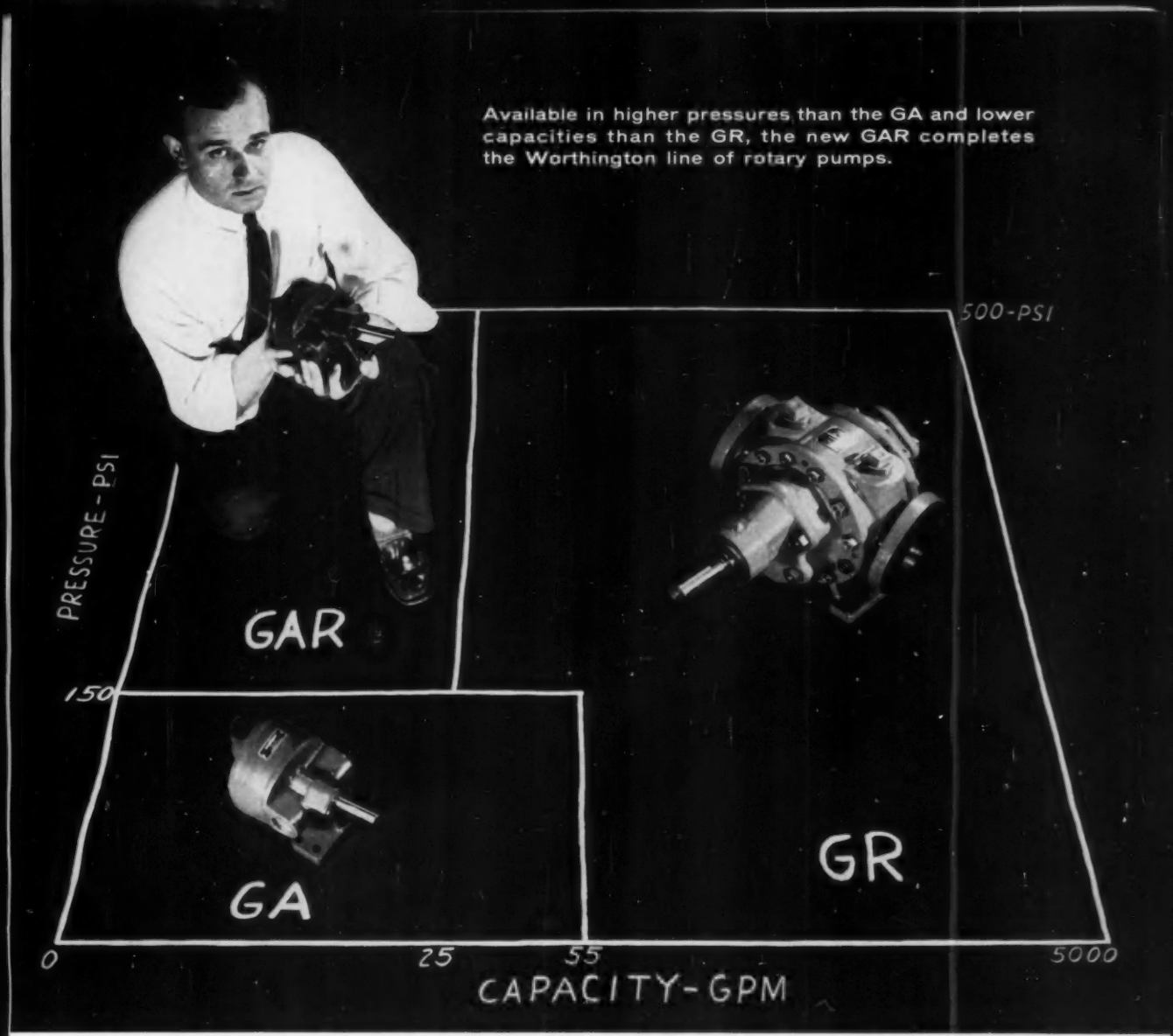

NEW ROTARY PUMP

offers new economy in high pressure, low capacity range

Why sacrifice space, economy, and efficiency in high pressure, low capacity pumps? Here is a new line of internal roller bearing, herringbone gear pumps, designed for continuous operation up to 500 psi in capacities to 25 gpm.

The new Worthington GAR pump is a flexible, rugged unit which provides long trouble-free service. Available in either foot-mounted or Monobloc design, it features heavy-duty, hardened steel roller bearings, nodular iron, double helical gears, and steel backed bronze filler plates which set it apart from the field.

The new GAR is just one of Worthington's complete line of rotary pumps—broadest on the market. Worthington offers 142 different standard rotaries to choose from plus many optional features such as mechanical seals and relief valves. Each pump is factory tested before shipment.

Preferred by users everywhere, Worthington rotaries are backed by service outlets throughout the country. See your Worthington representative for more information or write for descriptive bulletins. Address Section SP-74, Worthington Corporation, Harrison, N. J. In Canada: Worthington (Canada) 1955 Ltd., Brantford, Ont.

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American...

DEVELOPMENTS TO WATCH...

Carbon fibers that can be woven . . .

. . . into cloth or made into rope are now being tested for a host of uses including filtration, thermal insulation, semiconductor and nuclear applications.

Atomic Laboratories, Inc., Berkeley 5, Calif., is producing high-strength wool-like fibers in diameters ranging from 5 to 50 microns, and supplying them in bulk, pad, and rope form, activated or unactivated, with variable specific resistances. For high-temperature use, they can be given inert protective coatings, and they can also be coated with materials that will give them specific adsorption properties or permit their use as catalyst carriers.

Developmental price is $15 a pound (small samples free), but AL says larger quantities will cost less than half that much, with thousand-pound lots perhaps as low as $3 a pound.

The plastic-foam field is whipping up a lather . . .

. . . over polyether foams as replacements for the polyester urethanes that have dominated the field for the past few years. Proponents of the polyethers claim the new materials are potentially much lower in cost, stronger, and more abrasion-resistant than the polyesters, and they predict applications ranging from shock absorbers to thermal insulation.

General Tire & Rubber, which is converting all its production from polyester to polyether foams, enthusiastically claims "the versatility of this new product, coupled with its incredible strength and durability, will make all other cushioning materials obsolete."

But Armstrong-Norwalk Rubber, which is also concentrating on polyether foams, more cautiously points out that, while the polyethers have excellent resistance to many chemicals, oxygen, ozone, and sunlight, they can not stand live steam or solvent like perchlorethylene and Stoddard's reagent (chemicals commonly used for dry cleaning).

In addition to General Tire and Armstrong Rubber, a good many companies are supplying or getting ready to supply foamed polyethers or special formulations for foaming; and suppliers of the basic materials (polyether resins and/or isocyanates) now include Allied Chemical, DuPont, Mobay, Union Carbide, and Wyandotte.

Don't write off the polyesters, though. Polyethers so far are made only in soft, flexible form. Polyesters will quite likely still be needed for the rigid insulation used in sandwich panel construction and similar jobs, and their physical, chemical and mechanical properties may still be desirable in other applications as well.

What makes color preferences change? . . .

. . . Perhaps Buick's explanation is as good as any. Preference for blue, says Buick, seems to rise as the stock market rises; while black, green and gray advance as the market drops, and white may be an index of instability.

That's what you get, anyway, from plotting the popularity of auto-body colors against Dow-Jones averages. In 1950, green was the top color, and blue ranked fourth, taking 18% of sales. Then the market started to go up, and blue hit 30% in 1954. In 1956, the market was somewhat erratic, and white jumped into No. 1 spot, while blue slipped to third. What about 1957? A look at recent stock averages would indicate blue won't do too well, and *light* blues, at least, are going down, while white is increasingly popular.

Cutting the apron strings . . .

. . . to free products from their plug-in cords—can open markets for both industrial and consumer products, particularly if their electrical power requirements can be reduced.

A good example is a battery-operated electrolytic conductivity recorder just being introduced by Industrial Instruments, Inc., Cedar Grove, N. J. It uses a spring-driven clock to drive the chart, and a transistorized electronic circuit drawing less than 8 milliamperes, so two 6-volt batteries can do the job. In this case, at least, design for battery power did not raise the product's cost. Industrial Instrument says the recorder's price is comparable to that of line-power-operated units now on the market.

American...

(continued)

DEVELOPMENTS TO WATCH...

They'll be cooking by slide rule . . .

. . . in the 1970's, says the American Hotel Association. And that means plenty of work to be done in developing automatic handling equipment and controls. "Foreseeable developments in foods and cooking," says the association, should make it possible for the chef, sitting in his glass-enclosed control room, to press a button that will automatically start food moving from the freezer to the microwave oven, thence to the table, by automatic conveyor and self-propelled cart. "There will even be an automatic self-propelled device," the AHA predicts hopefully, "to seek out and sweep up crumbs."

Thermal problems may not be quite as rough . . .

. . . as originally expected—even in the hyperthermatic range. The reason: Most discussion has centered around stagnation temperature (the temperature reached when air is brought to rest from its initial speed). At Mach 10, the Air Force's current goal, stagnation temperature is more than 6000 F. But, as Maury Sulkin of North American Aviation points out, such a temperature is not maintained.

More important is the equilbrium temperature. It is only about 1000 F, and that's a goal not too hard to reach. Quite a few types of equipment can now stand temperatures twice that high for short periods at least—perhaps long enough to get through the stagnation-temperature phase.

Fatigue life of steel tubing can be extended . . .

. . . and lighter-weight tubing can be used, if the metal is stressed hydraulically after forming, the Air Force reports. Investigations at Douglas Aircraft show that if corrosion-resistant steel tubing, of the type used in aircraft hydraulic systems, is subjected to a high hydrostatic pressure (applied inside the tubing) fatigue life can be extended as much as 30%, permitting a corresponding weight reduction. Furthermore, the higher the pressure, the greater the fatigue life—as long as the pulsing pressure is not more than half the tubing-burst pressure. Two cautions, though: The stress must be applied without rigid restraint on the tubing, and it is important that there be no subsequent rework.

The possibilities of special-interest groups . . .

. . . offer a big potential for new product development. For instance, (photo, right) there is a new can opener specifically designed for handicapped people, and there are many other groups with new-product potential: older people, teen-agers, sports enthusiasts—also (why not?) product engineers, and women too. There are lots of products expressly designed for women, of course. But there's plenty of room for more, as witness the overnight acceptance of the "lady shaver." One manufacturer is following up on this success with a series of snubnosed .22 calibre pistols in turquoise, pink, and other pastel shades. Just the things, the manufacturer says, for presentation pieces, trophies, and home-protection gifts. Price: $49.50.

WITH JUST ONE HAND, **almost any kind of can may be opened on this Rival Single-Hander. It's specifically designed for handicapped people, has magnetic holders, vacuum base. Bottom lever operates elevator platform that raises can into position. Top lever pierces lid.**

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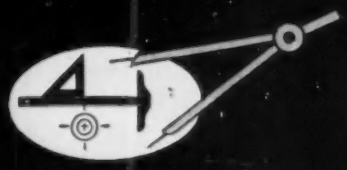


in design

An acid handling problem solved with a liner of HYPALON

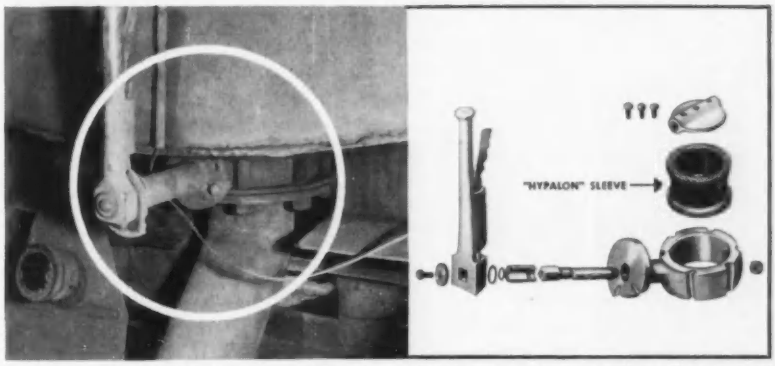
Expanding grinding head of neoprene holds abrasives without spindle nuts

Another new use for Du Pont neoprene is this grinding head made by a midwestern manufacturing company. The head—a slotted neoprene wheel—permits instant changes of the abrasive sleeve merely by slipping it on or off. There are no spindle nuts to tighten, no tools needed. When the motor is started, centrifugal force expands the resilient neoprene against the inner surface of the abrasive element and holds it firmly in place as it grinds.

Downtime for changing abrasives is cut to a minimum. Abrasive life is increased considerably. Smoother performance is assured. And neoprene's resiliency also makes possible higher quality contour work. The expanding wheels are made in sizes from ½-in. to 18-in. diameters.

Neoprene's resilience is one of a *balanced combination* of properties which adapt it to a wide variety of industrial applications. Its resistance to sunlight and weather, abrasion, oil, grease and chemicals means long-term wear—and economy in many types of service. Mail coupon for full information on neoprene.

Resilient neoprene grinding head expands under centrifugal force and holds abrasive sleeve in place as it grinds. No nuts or tools are required.



Butterfly valve lined with HYPALON has handled spent acids three years without replacement.

Metal damper rotates in ring-piece with a sleeve of HYPALON. Squeezed shut, the sleeve makes a pressure-tight seal. Opened, it returns to its original shape.

6-in. butterfly valves weighing only 30 lbs. replace 250-lb. models

Industrial Wastes, Inc., of Beaver Falls, Pa., hauls and neutralizes spent acids from Pittsburgh steel mills. Each month its tank trucks handle 2½ million gallons of spent acid—mixtures of nitric, sulfuric, hydrochloric and hydrofluoric.

For years Industrial Wastes, Inc., tried various outlet valves, but even the most satisfactory valve had disadvantages. Made of expensive and heavy metals, the valve weighed 250 lbs., which made it cumbersome to install and required special supports to prevent stress fatigue in the tank shell. Too, sediment clogging meant frequent cleaning of the valve through a rodding-out hole. This damaged the neoprene tank lining and reduced its protection against acid corrosion of the shell.

Three years ago the company installed a self-cleaning 30-lb. butterfly valve with a resilient sleeve of HYPALON. In this case, HYPALON not only protects the metal valve body from corrosion, but acts as a resilient valve seat for the butterfly as well as a flange for the gasket. The original lightweight valve—a design that cost 40% less than previous valves—is still in service.

The excellent chemical resistance of HYPALON, Du Pont's *newest* synthetic rubber, made it the logical choice for this design. HYPALON has many properties you'll find useful when your design calls for a resilient material with good resistance to most chemicals, temperatures of 250° F.-350° F., ozone concentrations or other tough operating conditions. For more information on the properties of HYPALON, merely mail the coupon below.

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American ...

(continued)

DEVELOPMENTS TO WATCH...

Electricity is being made from gases . . .

. . . at National Carbon's Research Laboratory—with an efficiency of 65 to 80%. A new fuel cell that "converts the chemical energy of hydrogen and oxygen directly into electricity . . . is capable of economically producing thousands of watts of power," says C. E. Larson, NC's research vice-president.

Basically, the cell is a container, filled with electrolyte (potassium hydroxide), in which are immersed two hollow, porous, carbon electrodes. They feed hydrogen and oxygen into the cell, and conduct electricity from it. In operation, an electrochemical reaction at the hydrogen electrode releases electrons that flow through the external circuit and return to the cell at the oxygen electrode. Neither heat nor pressure is required and, Larson notes, commercial-grade hydrogen and air can serve if current-density requirements are low.

The cell can be used wherever portable power is needed, Larson believes. He suggests such interesting jobs as storage of solar and nuclear energy; operation of lawn mowers, outboard motors, and perhaps even small cars.

36-inch plastic lenses, costing a tenth . . .

. . . of comparable glass optics, have been made at Pacific Optical Corp., Inglewood, Cal. And, says company Vice-president Arthur S. Lochner, "we can build them much larger." The advantages of plastics are, their light weight, formability, (plastic lenses machined or molded with integral mounting flanges, holes, and threads), and resistance to shattering. Their flexibility often eliminates the need for cushioning. Furthermore, their optical characteristics can now be varied, so that "simple optical systems having satisfactory corrections for spherical and achromatic aberration may be designed." However, Lochner points out, "no plastics have been developed which have the outstanding index and dispersion characteristics of the dense barium-crown and rare-earth types of optical glasses." Too, they deform when heated, scratch easily, and it is difficult to obtain a satisfactory low-reflectance coating. Progress is being made on the last two counts, though (see below, and Sept 9, p 13).

Transparent conductive coatings . . .

. . . that also reflect infrared radiation are being applied to plastics by Sierracin Corp., Burbank, Cal. First tests are on aircraft glazing materials—canopies, windshields, helmet visors—but the coatings could well prove useful for furnace and cold-chamber windows, and automotive applications.

These are metallic coatings, applied by vapor deposition, and the process does involve a certain amount of heat; so they cannot be applied to all thermoplastics. However, Sierracin has its own heat-resistant plastic formulation which, it says, takes the coating very well. Once applied, the coating will stand ambient temperatures as high as 275 F.

As would be expected, the coating reduces light transmission, but reduction is only about 20% for coatings with specific resistivities of 7 to 20 ohms.

Explosion-proof equipment still offers . . .

. . . many new product and marketing opportunities. Just last month, for instance, Hild Floor Machine Co. introduced "the first and only" UL-approved explosion-proof floor polishing and scrubbing machine (equipped with static-conductive bristles as well as an explosion-proof motor).

The list of UL-approved equipment is long, but there are still many categories which have only one or two entries, several in which equipment has been approved only for limited use, and some where no electrical equipment has yet been listed.

For example, several types of telemetering equipment have been approved for use in Class I, Group D locations (atmospheres containing gasoline and petroleum solvents), but none for atmospheres containing acetylene, hydrogen gas, metal dusts, carbon black, or grain dusts. And there is no electrical equipment approved for use where dusts of high explosives are present.

Copies of UL standards, lists of equipment approved for use in hazardous locations, and a list of electrically conductive components, may be obtained from UL offices in New York, Chicago and Santa Clara, California.

FAST, HAMMER-DRIVEN RIVET ECONOMICAL FOR BLIND AND OPEN APPLICATIONS

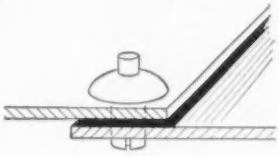

Fig. 1 Inserted in hole, Southco Rivets are quickly set by driving pin with hammer. No special tools are required. Bucking is not necessary.

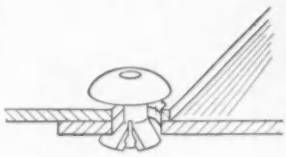

Fig. 2 Expanded prongs force sheets or parts together, hold them tightly in compression. No metal is removed, no grinding or finishing is required.

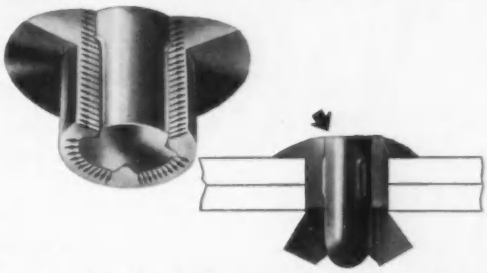

Fig. 3 Pin is locked securely into rivet by displaced metal filling unique grooves. Compression forces are utilized for greater strength.

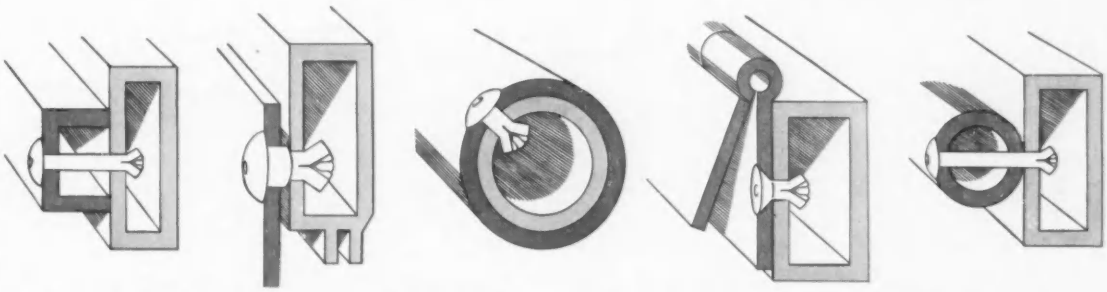

Fig. 4 Ideally suited for "blind" applications, Southco Rivets are worked by one man from one side only and require minimum space inside closed area. They eliminate costly bucking arrangement or time-consuming finishing. Supplied as a unit, they require no job time for assembly or fitting.

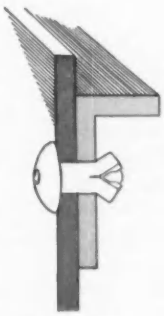

Fig. 5 Access or open fastening utilizes the simplicity, speed and vibration-resistance of Southco Rivets.

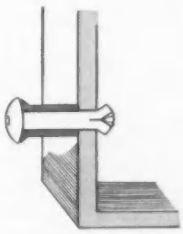

Fig. 6 Ferrules are used as spacers for numerous applications. Here the Southco Rivet forms a drawer pull in conjunction with a flanged tube.

Fig. 7 Increased head size distributes holding pressure over larger area, permits higher loading on wood, plastics and similar materials.

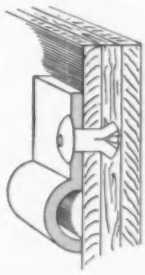

Fig. 8 A blind head can be formed inside the wood. This application is particularly useful when it is desirable to have one surface of the wood unmarred.

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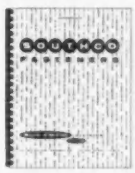

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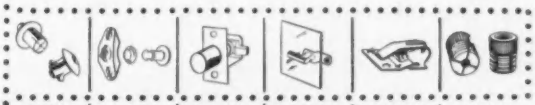

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DEVELOPMENTS TO WATCH...

Risks in accepting government contracts . . .

. . . will be stressed in an upcoming report by the National Security Industrial Assn., an organization of some 500 companies with government contracts. Reportedly, it will say that big business often takes a beating on such contracts. Also up for discussion: contract cancellations and renegotiations.

The report, over a year in the making, will be signed by some 50 big-name contractors. It was prepared by the procurement advisory committee of NSIA and is likely to draw fire from both the Pentagon and small contractors. Many subcontractors already are complaining about being squeezed out of government contracts because of the trend toward prime contractors handling their own sub work.

Navy's shift to electronic data processing . . .

. . . for inventory control is paying off. Some 30 months ago it had 1.3-million items in its supply system. Today, there are 100,000 less. This despite 10,000 new items being added each month. Navy claims the computers save manpower, reduce inventories, and help spot obsolescence. It cuts buying too. Now, Navy buys spare parts based on accurate usage of parts data rather than on the best guess. This means less warehousing. It is not feasible to store spare parts at each air station for the many types of Navy planes. So, parts for a specific plane are stored at one field, others at another field.

Missile budgets are no longer automatically safe . . .

. . . from the Administration's drive to save money and help keep the federal budget in line. Big chunks of money aren't going to be saved; spending on missiles will keep going up. But there will be a sharper review of dollars being spent by missile contractors, and items deemed wasteful will not be allowed. For instance: padded overtime pay for engineers won't be approved; there's a stretchout on the Air Force's Titan, which means that some of the "crash" is being taken out of this crash program. Martin and Aerojet General's Titan is a more advanced design than the Atlas (Convair-North American) but it was started later; funds for the Navy's Polaris IRBM (Lockheed-Aerojet General) have been cut back.

An increase in the price of tungsten . . .

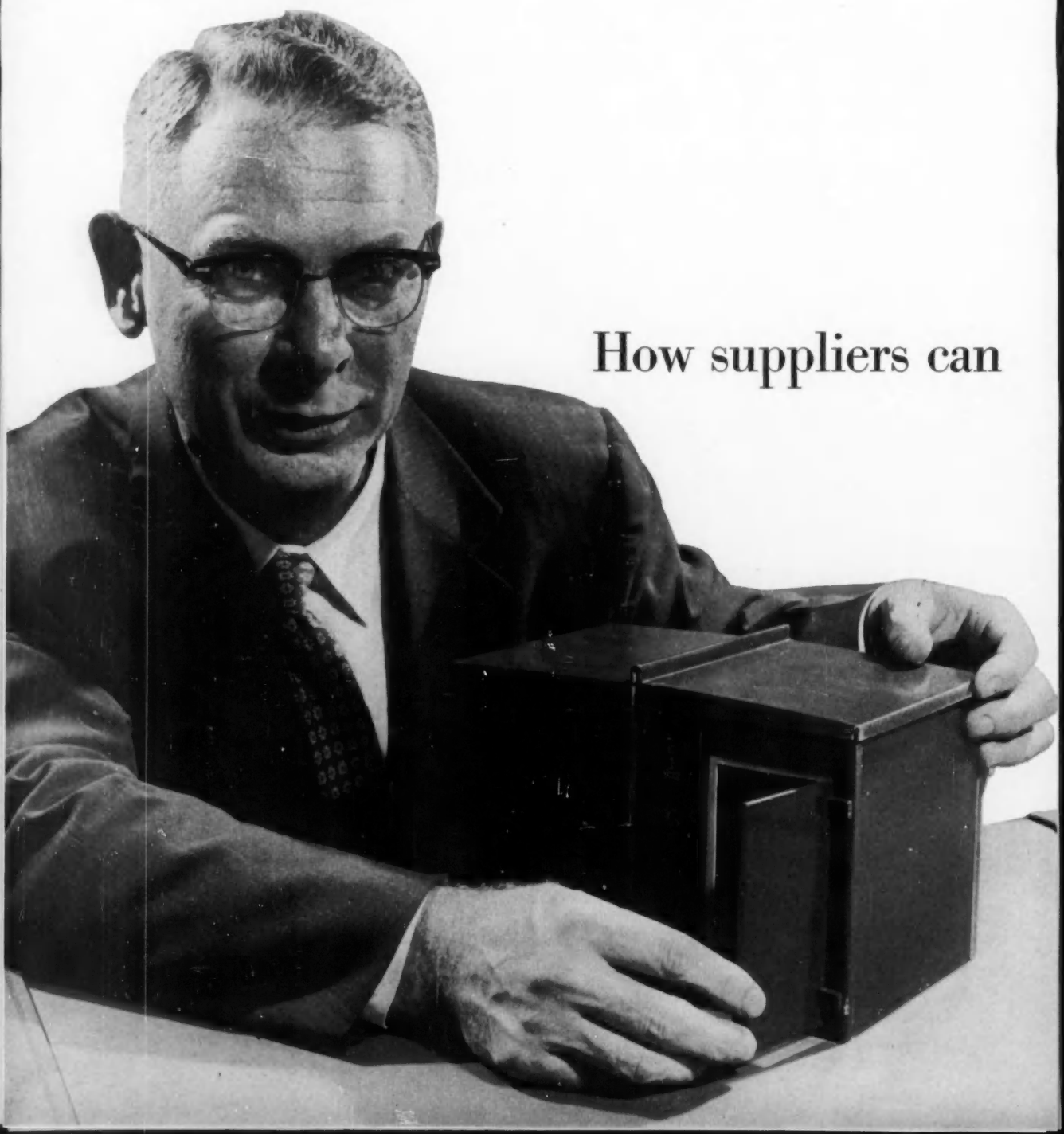
. . . is behind recent Washington moves. In the closing session of Congress, the Colorado-Nevada Senators pushed through a resolution directing the US Tariff Commission to investigate the differences between the cost of producing domestic tungsten ores and concentrates and foreign costs. It is to report back to Congress by March 1, 1958. Tariff Commission hearings are expected to be held during the fall.

Higher tariffs on imported ores explain the move. Right now, there is a $0.50 per lb duty on the tungsten content of imported ores. At current prices, it makes the cost of a short ton of tungsten trioxide around $23 (15.8 lb of tungsten content). And domestic prices have to match this in order to sell.

A research department cannot afford to standardize . . .

. . . its product or its personnel, according to Dr. W. D. Lewis of Bell Telephone Labs. The statement was made recently to over 150 of the top research administrators at the 11th National Conference on the Administration of Research, a three-day closed-door conference hosted by Johns Hopkins University. Both government and industry officials aired problems ranging from measurement of research accomplishment to how big research and engineering teams should be. Dr. Lewis said that creative power resides in the individual, and the best power of judgment in the group. Comparisons show less quantity but better quality of output when group research teams are used. For the best team, see that members have different characteristics, different skills, and make different contributions.

Under Mr. A. A. Johnson's guidance, 175 Westinghouse design engineers work concentratedly at the job of making Westinghouse switchgear and related equipment outstanding examples of why "You Can Be Sure If It's Westinghouse". Mr. Johnson's responsibilities have been recently expanded to include the management of manufacturing and sales, as well as the engineering, of over $50 million worth of switchgear annually.



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DEVELOPMENTS TO WATCH...

Asbestos from South America . . .

. . . is slated to move into US electrical and refrigeration equipment, machine parts, and instrument cases in the form of reinforced polyester molding compounds. World Commerce Corporation, S.A., is now ready to market chrysotile fiber mined in Venezuela and specifically prepared for this purpose. WCC claims this Amveco fiber is unusually low in talc and free of impurities, and has a neutral pH. It can be formulated with aluminum silicate, calcium carbonate, and other inert fillers to increase "body" and reduce cost.

Other advantages claimed for asbestos-reinforced polyesters of this type: good uniformity, high flexural modulus, resistance to warping.

Mammoth plastic ventilator . . .

. . . with an all-plastic (polyvinyl chloride) turbine weighing 1500 pounds, has been built and tested in France by Etamlissements Neu to handle acid gases in a chemical plant. It's believed to be the largest unit of its kind thus far. *France Actuelle* reports that the ventilator can handle a gas volume of 150,000 cubic meters an hour. The French, incidentally, have done a good deal of work in the vinyl resin field, and are currently exporting about a quarter million pounds a year to the U. S.

Rubber-bonded fibrous materials . . .

. . . are being developed in Sweden and Germany to go in separators for electric accumulators and battery cells, and in new types of cushioning and padding.

The Natural Rubber Development Board reports that Aktiebolaget Tudor of Sweden has produced battery separators with a porosity of more than 75%, in thickness down to 0.5 mm, by impregnating sheets of matted, pre-bonded glass fibers with natural rubber latex, then vulcanizing the material. In this case, the latex coagulant is added to the glass-fiber mat before impregnation, rather than to the latex.

From C. Freudenberg K-G Auf Aktien comes a porous, crease-resistant, shrinkproof fibrous material with possibilities for padding and cushioning applications. This one is made with foamed latex. First, the fibers are treated with the foam, then the foam cells are collapsed by a drying process, leaving a material of maximum porosity.

New batteries from Australia . . .

. . . shoot for longer life. The Australian Defense Standards Laboratories, working on the problem of battery deterioration in tropical climates, have come up with a new insulant for standard-type multicell batteries, and a treatment to prevent deterioration in storage. It is simply dehydration to remove the moisture that causes the trouble. To take advantage of the treatment, a polyvinylchloride inter-cell insultant is used, and the cells are housed in a polyethylene case. Cells are reactivated by water immersion.

50 miles to the gallon . . .

. . . is the aim of the British auto makers, and they hope to reach it "within the next few years." They probably will too. The smaller British cars are not too far from the goal now.

In tests at Bonneville Salt Flats late last month, a car equipped with a Morris 1000 4-cyl, 948-cc engine got better than 40 miles a gallon at a speed of 118 mph, and broke more than 60 national and international speed and endurance records.

How do the British manufacturers expect to reach the 50 mpg level? Dr. Albert Fogg, director of the British Motor Industry Research, says a major effort is being directed toward research in the field of fuel conservation, particularly with respect to automatic transmission. This, he says, "will result in reduction of up to 30% in the fuel consumption of British automobiles in the near future." Right now, the British seem to be somewhat behind us in transmission design, but it doesn't look as if they will be behind us for long.

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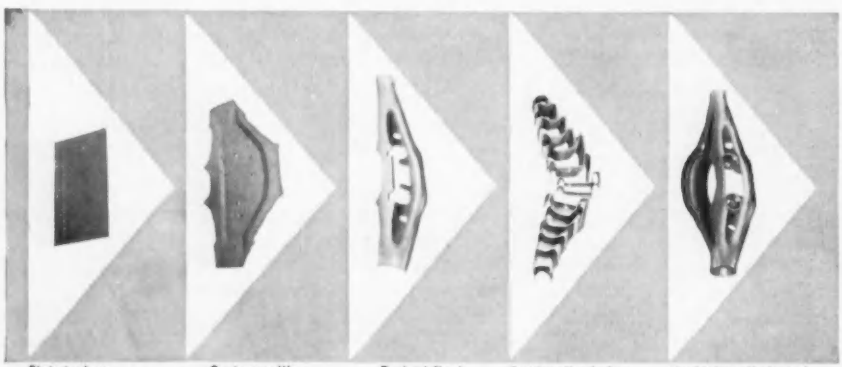

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What's happening in SCIENCE

New form of propulsion coming up?

Today we can see the end of the line in heat engines, says Brig. Gen. M. C. Demler, Deputy Commander for Research & Development of the USAF. What's next? Magneto fluid dynamics.

Says Gen. Demler: "Continuing development of heat engines will no doubt reward us with more range, speed, and payload capacity. But as long as we are dependent on increasing specific impulse, we are confronted with many barriers . . . weight of working fluids, high factors of acceleration, cost of exotic fuels," and the heat generated by the combustion process itself.

Furthermore, he points out, the random manner in which the particles released by combustion flow against the walls of the combustion chamber is itself a barrier—much of the energy of chemical fuels is not utilized or directed to obtain propulsion.

We cannot completely discount the thermo-mechanical type of engine, he says, but it's time to look elsewhere—and the field of magneto fluid dynamics seems to be a good place to look.

Studies of magnetic particles under the influence of strong magnetic fields have shown that the particles can be so controlled that they are given a directional thrust, and they can also be deflected away from the walls of their propogation or combustion chamber, thus preventing heat loss. This opens the way for a new type of propulsion, and perhaps a whole new family of engines.

Much remains to be learned about harnessing this force. But the work has already begun.

It's the flicker that makes you twitch

Flickering lights can be so disturbing that they result in "drastic emotional and physiological upheaval," the Army Engineers report. At one time, the Army even considered using flickering lights as a weapon. The effects may not be quite severe enough for that purpose, but recent studies do indicate that flickering lights—indicators, for instance—should not be tolerated in consumer or industrial equipment. A Tulane University report notes that frequencies above 20 cps need not be considered because the eye cannot distinguish the individual pulses beyond that point; and frequencies of less than 7 cps are seen only as alternating patches of dark and light. But in between these limits the effects may be quite serious, with 9 cps apparently the most disturbing of all.

Neutrons to order; they'll uncoil the atom

The University of Arkansas gets the first "commercial" Cockcroft-Walton accelerator, a $70,000, 350,000-electron-volt model built by Applied Radiation Corp. Equipped with a tritium-zirconium target, the machine as now set up is expected to yield a hundred billion neutrons per sec. It's so designed that other targets (silver, for example) can be substituted, and other bombardment techniques used to increase the yield several-fold.

Work planned for the new machine includes fast neutron cross-section measurements, studies of chemical states formed in nuclear reactions, production of labeled organic compounds for tracer research.

NEW ACCELERATOR **has open design for ease of servicing; will produce high-energy neutrons for materials research.**

A cure for static

While basic-research laboratories are hard at work on atomic structure, industrial, labs are finding new jobs for atomic radiation.

This month, at a General Electric X-Ray Electron Beam Radiation Symposium, an interesting prediction came from Dr. R. B. Mesrobian of Continental Can's Central Research and Engineering Div. He noted first that irradiation can increase the ability of polymers to take up and hold a variety of pigments and particles. Then he suggested this may be a means for incorporating conductive particles that would reduce or eliminate the problem of static electricity in synthetic fibers and plastics.

Need materials? They're on the farm

Scores of new materials for industrial use could be produced from farm crops, says the Commission on Increased Industrial Use of Agricultural Products. Among them: insulating boards and panel boards made directly from grain, instead of just from agricultural residues; plastics, plasticizers and surface coatings from starch derivatives; ceramic glazes, rust preventives and abrasives from rice; waterproofers, resins and lubricants from oil-bearing seeds.

For many of these materials, the commission says, the groundwork is already laid. For instance, research has already shown that superior lacquers, varnishes, and cements can be produced from allyl starch, and a plastic molding material from periodate-oxidized starch. All that's needed now is an awareness of the possibilities and the necessary funds for research.

Help in both areas may soon be forthcoming. The survey itself outlined more than a hundred fruitful areas for research;and the Senate Committee on Agriculture and Forestry, to which the commission is reporting, may take action at the next session to increase Department of Agriculture research funds and initiate a campaign for industrial cooperation.

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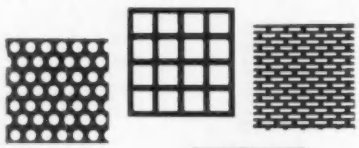

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SEPT.

23-25 **ASME Fall Meeting** at the Hotel Statler, Hartford, Conn. Papers cover hydraulics, gas turbine power, safety in machine design, engineering management, metals engineering, lubrication, and engineering education and materials handling.

24-25 **Industrial Electronics Symposium, 6th annual meeting,** Sponsored by the IRE and the AIEE, at Morrison Hotel, Chicago, Ill. Sessions cover: Transducers and Applications, Instrumentation, Digital Control Elements and Systems, and Control Circuits.

24-25 **Computer Applications Symposium, 4th annual meeting** Sponsored by the Armour Research Foundation at the Morrison Hotel, Chicago, Ill. First day sessions will cover business and management applications of computers for airline reservations, hospital records, retail store-warehouse requisitions etc. Second day will cover applications of computers in research and engineering.

OCT.

7-9 **ASME-ASLE Joint Conference on Lubrication** at the Royal York Hotel, Toronto, Canada. Sessions will cover recent experiments in wear, high temperature lubrication, factors affecting contact fatigue, boundary lubrication and fluid film lubricated bearings.

7-9 **National Electronics Conference,** Hotel Sherman, Chicago, Ill. Technical sessions will cover varied aspects of electronics including servomechanisms applications, semiconductor devices, microwaves, radio astronomy, computers, instrumentation, and circuit theory.

7-11 **AIEE Fall General Meeting** at the Hotel Morrison, Chicago, Ill. Program will include 50 sessions by the Institute's six technical divisions—Communications, General Applications, Industry, Instrumentation, Power and Science, and Electronics. Subject matter will span nuclear reactors, telegraph systems, research, ethics, basic science, safety, computing devices, and the chemical industry. Visits are scheduled to the Electro-Motive Div. of GM, Commonwealth Edison Co. to inspect electronic billing equipment, Argonne National Labs, and other places.

9-11 **Society for Experimental Stress Analysis, annual meeting** at the Hotel El Cortez, San Diego, Calif. Complete details may be obtained from Dr. M. W. Murray, Secretary-Treasurer, Post Office Box 168, Cambridge 39, Mass.

10-11 **National Noise Abatement Symposium,** Hotel Sherman, Chicago, Ill.

13-17 **Pressed Metal Institute, Annual Meeting,** Hotel, Bermuda.

14-18 **International Industrial Development Conference,** Fairmont Hotel, San Francisco, Calif. Conference is concerned with how private industry with government cooperation can increase the rate of industrial development and economic growth.

16-18 **IRE Canadian Convention.** Technical program will include 25 sessions and 116 papers. Feature session will be devoted to a description of Canada's part in the IGY. Another session will cover professional business management.

What's happening in MATERIALS

New Materials: interest up; consumption down

While interest in bismuth and molybdenum as "atomic age" materials is rising, commercial use is not. And though lithium and titanium are making progress, they're not leaping ahead. Widely heralded aircraft and nuclear applications for all four metals are apparently still in the future.

Bismuth, for instance, is being tested as a carrier for uranium in liquid-metal-fueled nuclear reactors. But this year's consumption is running about 4% less than last year's.

The Bureau of Mines estimated even before the molybdenum strike (see box) that shipments of this metal would be off, too.

The drop in bismuth and moly ties in with the general weakness in nonferrous metals. But the drop, rather than a rise, shows the new uses are developing more slowly than was hoped. Technical progress is being made, though, as the photo proves.

HIGH-PURITY MOLYBDENUM INGOTS, now coming from such new installations as this General Electric vacuum arc-melting furnace at Universal Cyclops, should permit design of larger parts. This ingot is 16 in. in diameter, weighs more than two tons.

BRIEFS . . .

MOLYBDENUM is becoming hard to get because of a strike at a major producing plant; but for most other materials, supply outruns demand.

COPPER PRICE has been on the skids. Early in the month, it sagged to 27¢ a lb in New York, 25¢ in London—sparking predictions of shifts from aluminum to copper (see below left). Meanwhile, demand for the light metal is none too strong anyway.

TIN has dropped below 95¢ and and there is talk of a small surplus by the end of the year.

RISING FREIGHT RATES and "higher manufacturing costs" get the blame for increased prices, despite light demand, for many materials—synthetic fibers and heavy chemicals as well as aluminum. Steelmakers are passing along their 7% freight increase. DuPont, on the other hand, has just cut the price of its Zytel nylon molding resin 10% (it has been $1.35 to $2.30), and two grades of Mylar polyester film for electrical insulation are down 25¢ a lb, to about $2 in most gages.

Primary contender in special metals

A new combination, with assets exceeding $55 million, throws its hat in the special-metals ring. National Distillers Chemical Corp., P. R. Mallory & Co., and Sharon Steel Corp. have pooled their interests in titanium, zirconium, hafnium, and light metals, forming a joint company to produce and market those metals. It will take over the Mallory-Sharon name, and absorb Reactive Metals, Inc., now owned by National and M-S. The consolidation is expected to be fully effective by the end of the year.

Aluminum and copper switching positions?

For the first time in a decade, a pound of copper cost less than a pound of aluminum this month (see box). The big event set off a raft of speculation on possible substitution of copper for aluminum.

Aluminum still has the edge on a volume basis, when the weight of the two materials is taken into account. It also has a better record of price stability. On the other hand, copper's ease of fabrication, and its outstanding chemical and electrical properties, are strong points in its favor.

Synthetic mica passes road test

Reconstituted mica insulation is ready for the big jobs. General Electric reports Ford Motor Co. is using it on a big scale to insulate generators and starters.

Ford says the Mica Mat insulation stands an operating temperature of 160 C, at commutator speeds of over 12,000 rpm, and makes possible a new commutator-segment design that gives considerable savings in copper.

Methylstyrenes: Ready to roll

Into full production, after several years of development, come American Cynamid's methylstyrene plastics—priced, as predicted, in the polystyrene range. (The least-expensive grade is just 26¢ a lb in quantity; the most expensive, 43½¢.)

Transparent, boilable, and said to be unusually tough and abrasion-resistant, the Cymac molding materials (there are two: one a polymethylstyrene; the other, copolymerized with acrylonitrile) have not yet found a large-scale product use. But they are available in carload lots, and in a wide range of colors (19 for the polymethylstyrene) and are now being evaluated for control panels, junction boxes, battery cells, and mechanical parts.

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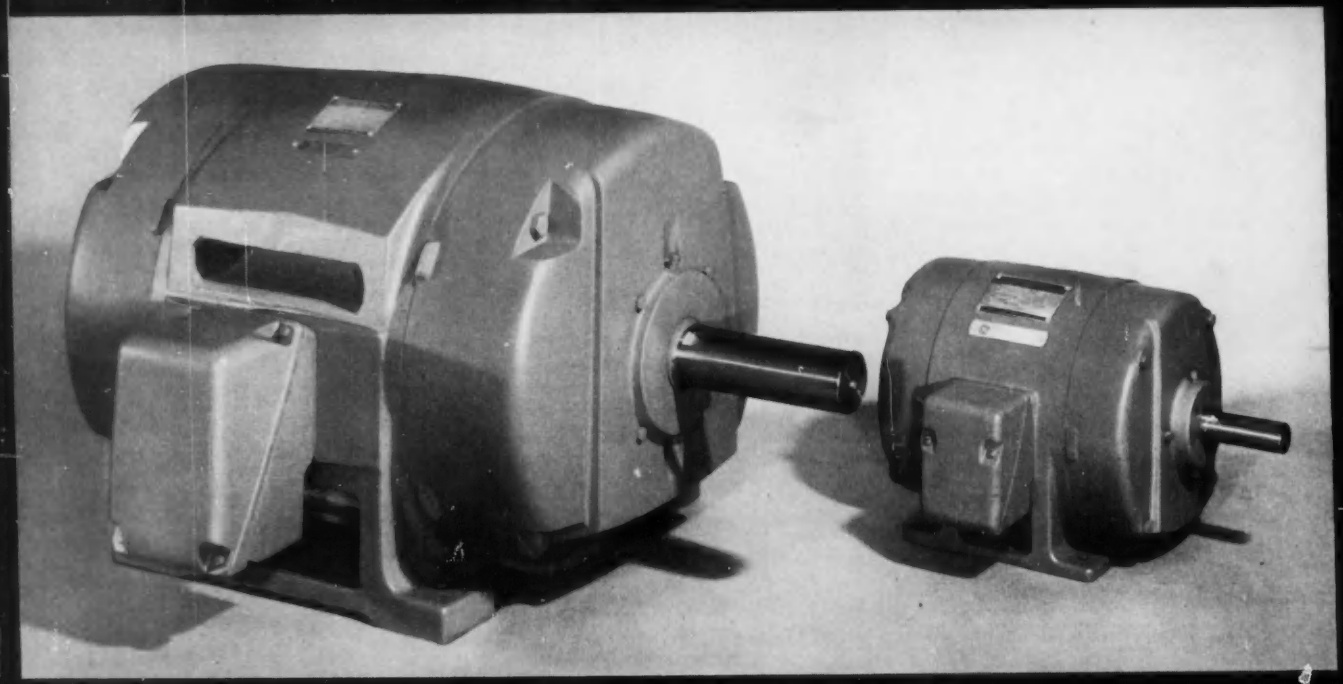

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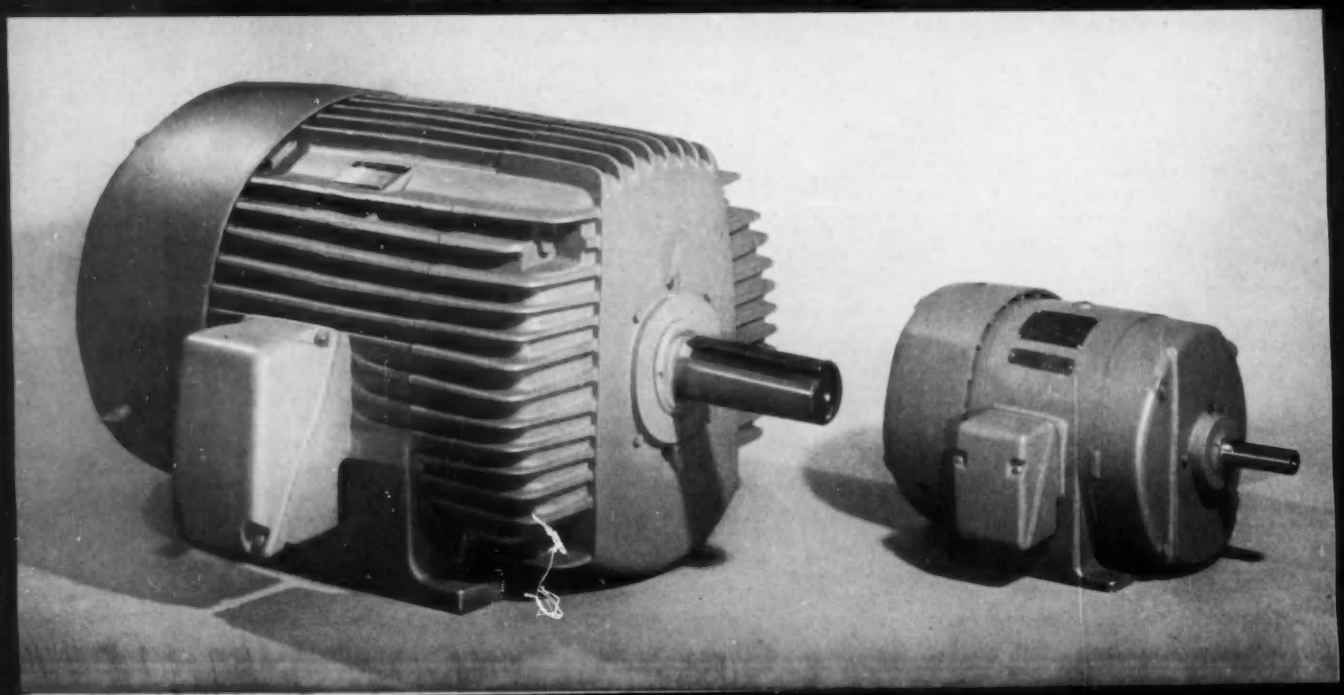

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TO 125 HP

YEARS AHEAD BENEFITS

DESIGNED TO CUT COSTS—Up to 32% lighter and 50% smaller, new NEMA rated Tri-Clad '55' motors offer big savings on shipping, handling and storage costs. These more powerful, more compact motors permit big space savings on many machine designs.

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DESIGNED FOR EASY INSTALLATION—Perma-numbered leads simplify wiring and speed motor hook-up. Numbers are stamped on terminals and printed on every half inch of the Geoprene® lead covering. Leads are always identifiable even when taped or clipped.

FOR COMPLETE INFORMATION

FOR COMPLETE DETAILS on the new line of Tri-Clad '55' motors up to 125 hp, contact your local G-E motor distributor or the sales engineer at your nearby General Electric Apparatus Sales Office. You will get expert assistance in selecting and applying the right motor for your particular application.

FOR FREE SLIDE RULE—which lets you determine at a glance the weight and space-saving benefits of recently announced NEMA standards for larger motors—and for informative, free General Electric Tri-Clad '55' motor bulletin, please send attached coupon.

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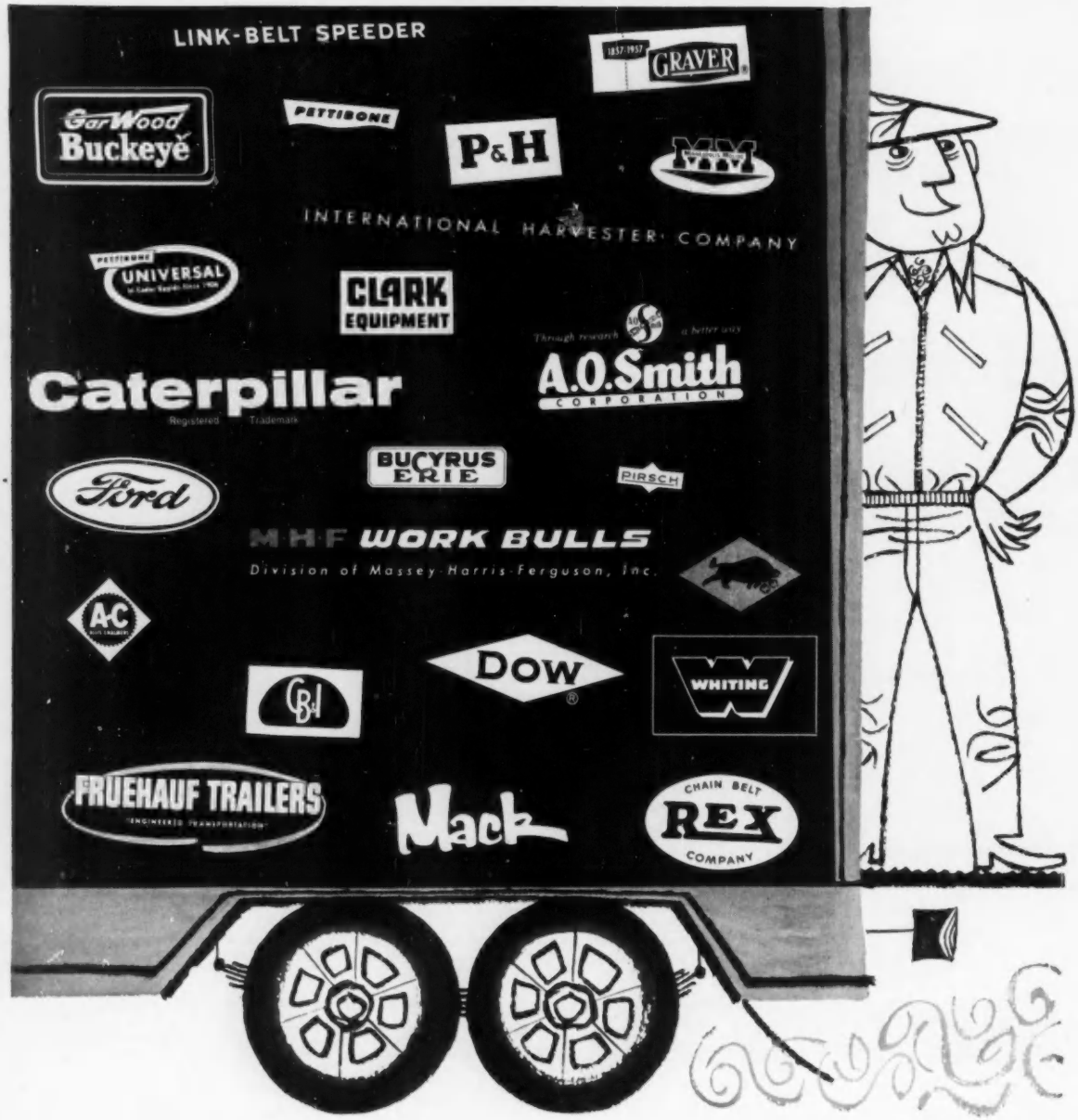

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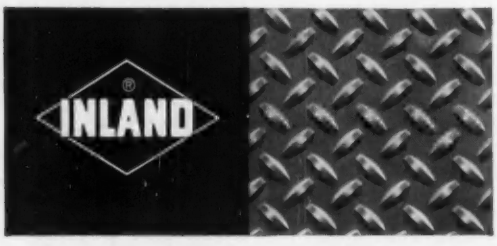

Are We Short of ENGINEERS?

Is there, or is there not, a shortage of engineers and scientists? Despite day-to-day changes in opinion and the actual situation, there are evidences of a long-term shortage that may not be denied.

Back at the turn of the century, there was one engineer or scientist among each 1800 people. By 1950, there was one in 300. By 1980, the ratio is expected to be 1:90; by 2000, it will be 1:40. Since 1800, we have multiplied both the annual production and the available supply of engineers and scientists by ten every half-century. By 1980, we are expected to have 1,700,000 engineers and scientists; by 2000, the total will be almost 3,300,000!

Despite such growth in numbers, the need is growing faster. Projected long-term research and development appropriations indicate there'll be only half enough men for the jobs by 1982, and only a third the necessary number by 2000.

In 1920, only about 3% of the 22-year-olds were college graduates. Ten years later, this figure had doubled. In 1940, the figure was 8%; in 1950, it had risen to 11%. The plateau is expected to occur about 1970 at 17%. But of these college graduates, only 18 to 22% are in engineering or science. And only two-thirds of the engineers and a third of the scientists stay in their fields.

Only three of every hundred American youths who enter school are graduated with technical degrees; only 13 get any degree at all. Although the average intellectual capacity of college graduates is 120 on a scale of 100–some as low as 80 get degrees, and only two out of three of those at 140 and above get degrees. Personality and aggressiveness are factors in the attrition, but so is such a mundane thing as weak elementary and secondary school training in math! (A recent check of 60 math teachers in these schools showed that only ten were competent –and math is the basis of technology.)

Basically, we have not yet realized how much emphasis should be placed on early direction of competent youth toward engineering, and how much effort should be spent in seeing that students with suitable intellectual capacity go on to a degree.

Soviet Russia faced this problem some time ago, and provided several typical totalitarian solutions. Half of all Russian college graduates are in agriculture, medicine, teaching, and engineering. Some 60% of those are in engineering and science. So Russia is currently graduating twice as many engineers as we are. With a notable shortage of men, Russia directed women into the professions, so now 50% of her professional workers, and 20% of her engineers, are women. And there is no worry there about the humanities; the graduate is a specialist for a special job. His or her rewards come in a better apartment and a car, not in the fuller life.

Any number of factors can affect our immediate and our long-term future as a nation. But granted escape from annihilation or other catastrophe, we are going to be technologically under-supplied to an increasing extent as time goes by. This is no passing situation. The sooner we realize this, the sooner we can begin to correct it.

Much of this corrective influence can come from Engineers and Management men. We need to do more NOW.

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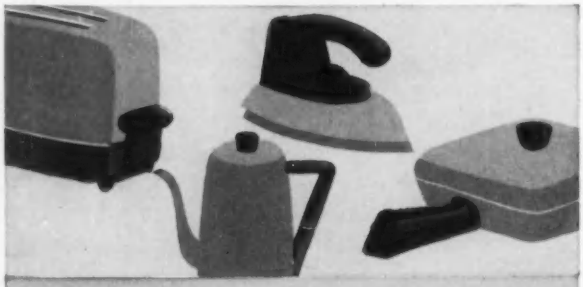


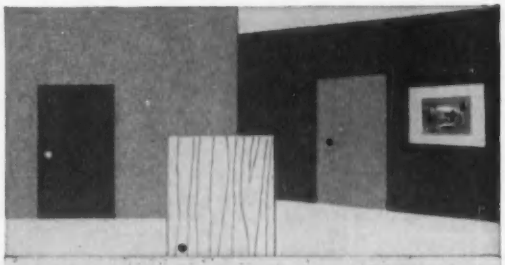
APPLIANCE HANDLES to match any color decor of the modern kitchen are now possible. The exceptional heat stability of DAPON resin molding compounds (producible in a wide range of colors) permits the finished article to withstand high temperature exposure for prolonged periods of time with substantially no loss or change in color. Moldability of DAPON resin compounds is excellent. Added advantages of good impact strength, high detergent resistance, unmatched resistance to food and beverage staining make DAPON the number one resin for appliance handles.

DAPON resin is a solid prepolymer of diallyl phthalate; making available the outstanding properties of this material in a form readily usable in all types of thermosetting resin operations.

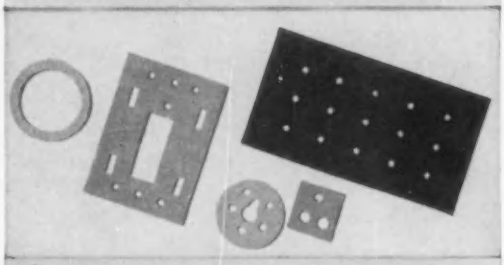
In selected applications these properties are unmatched by existing resins. DAPON resin should be evaluated for use as the base resin in any thermosetting application requiring chemical resistance, heat and humidity resistance, superior electrical properties, good moldability, or dimensional stability.

Extensive testing programs have been completed to point up those uses and applications in which DAPON resin has distinct merit and produces decidedly better properties. Molding compounds with various fillers, reinforcing fibers and colors are now available. Government approval under a number of military specifications has been obtained.

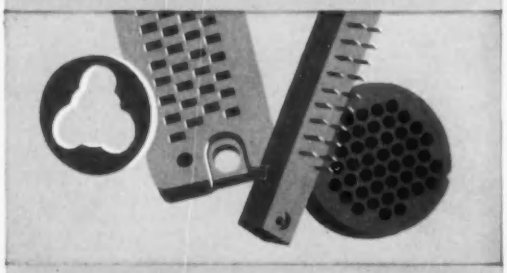
Let us know the application you have in mind for DAPON resin . . . write now for literature and technical data.



DECORATIVE LAMINATES made with DAPON resin do not require the usual "facing" steps. The printed paper can be laminated directly to the backing material in a single operation. For applications requiring soft backing materials excellent flows can be effected at pressures as low as 50 psi. With either high or low pressures, laminates of DAPON resin exhibit exceptional resistance to abrasion, chemicals and heat.



INDUSTRIAL LAMINATES made with DAPON resin have a number of outstanding properties: Superior electrical properties e.g., high insulation resistance retained under conditions of high humidity; heat resistance without degradation even under sustained vibrational stress. Other advantages exist in end uses requiring a high degree of chemical and moisture resistance, good dimensional stability, mechanical strength and ease of machinability. Formulated with or without volatile solvents DAPON resin is suitable for use in the full range of pressure curing conditions.



MOLDED ELECTRICAL PARTS containing DAPON resin exhibit highest resistance to humidity changes. Maximum retention and rapid recovery of electrical properties are insured by the unmatched stability of DAPON resin and the absence of deleterious products of degradation under long term use conditions. Properties of dielectric strength, dielectric loss, volume resistivity and arc resistance are particularly outstanding. Very low molding and post molding shrinkage allow close tolerances and the use of closely spaced inserts. Moldability and resistance to heat and chemicals are excellent.

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ACF Introduces More Efficient Cold-draw Process

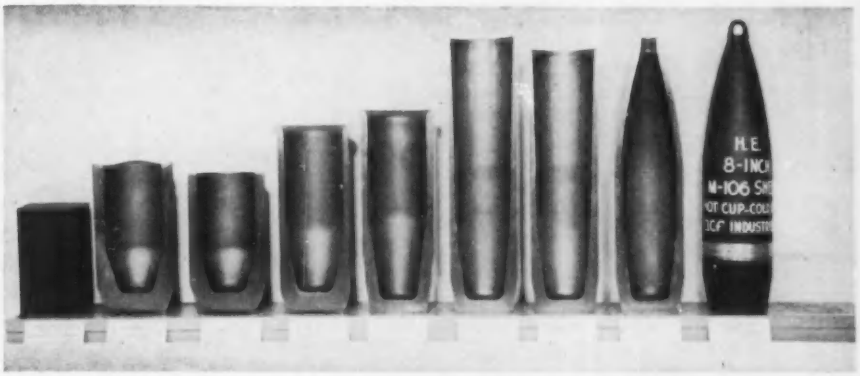
WASHINGTON—A hot-cup, cold-draw process that will manufacture 8-in. M-106 shells for Army Ordnance has been developed by American Car & Foundry Div., ACF Industries, Inc., under the supervision of Frankford Arsenal. The method requires half the trained manpower and up to a third less steel than the conventional machining process. It also increases by 2 in. the maximum diameter achieved by existing cold-draw methods.

ACF's process will have broad application for non-defense industry as well as for the military. For example, it is expected to prove valuable in making parts for the automobile industry, and for road-building machinery components.

Beginning with a 7⅛-in., round-cornered square, hot-rolled billet weighing about 190 lb, the M-106 undergoes a rough machining, five cold-working operations and three phosphate lubrications.

The slug is first sawed to length, then forged into a hot cup from a mult heated at 2100 F. Next, a rough machining that faces the open end of the forging removes surface defeats and assures concentricity.

The first phos lubrication is followed by a forward extrusion forming the lip. The second phos lubrication is followed by the coining operation and, after the lip has been softened, a drawing operation. Coining prepares the shell for the one-step nosing operation, considered by ACF a process highlight.



Billet to shell: 9-stage process uses less manpower, less steel.

The third and final phos lubrication is applied next, then an expanded bourrelet operation. This is followed by nosing the previously faced and chamfered open end. After nosing, the shell wall has the exact thickness dimensions required by military specifications.

The nosed piece is now ready for stress relief, followed by conventional operations that include: grinding the bourrelet, facing and boring the nose, machining the band seat, applying the band, machining the band, welding the base plate, pre-paint phosphatizing and spray painting.

Weight variation is 18 oz, far less than the 4 lb allowed by Army for this shell. Other alloy steels that may be used are the 86xx and 41xx series, as well as certain stainless steels.

One manufacturer has indicated that 500,000 units can be processed on one set of tools to provide an optimistic yardstick for measuring tool life.

ACF spokesmen indicate that a 10-in.-dia product using the process is possible, but the company's initial orders, starting in October, are keyed to production of the 8-in. M-106. It's success with the process dates back to 1954 when a feasibility contract was awarded by Army Ordnance and development work began at the Berwick, Pa., plant.

Custom-built Machine Tools Cue New Trends in Industry

NEW YORK—New ideas in materials, design, control and drives oftener than not appear first in custom-built machine tools. Such tools bear close watching because, as bellwethers, they signalize new developments and trends which, directly or with slight modifications, may soon spread to all industrial machinery.

Two of the developments involve strategy:

(1) Research results find their way into working models faster—because competition in machine tools is keen and becoming more so. No longer can there be a wait of five years between models to suit quintennial shows.

(2) Although new equipment is special in design rather than standard, the larger customers, such as automobile plants, are insisting that the components be standard and interchangeable—even between different makes. This permits accessories to be switched from machine to machine.

Even major assemblies—gearboxes, drives, heads, inspection equipment—are often designed for quick replacement. The ultimate in this direction is the "erector-set" or "building-block" design in which machines are really assemblies of standard components, variously put together to do specific

jobs. Look for this influence wherever complex and expensive equipment will be used in a specialized application, or wherever downtime of one part of a process line would force the whole line to go down.

Automatic Control

An outstanding trend in control is toward recorded information—such as tape, punched cards, and memory cells. This covers complete machine control, including contour following (now well established) and table and work positioning on jig borers and other precision machines. Programmed motion control suggests application to automatic assembly, warehouse storage and removal, batch processing in chemical and steel production. The change of programs is easy; unfortunately, highly trained personnel are needed to set up programs.

Automatic gaging moves hand in hand with automatic programming. A machine must be able to check its own operation and correct for errors, or much of the speed and versatility of new controls is wasted.

Control-Station Design Type

Much thought has been put into control-station design. Studies in human engineering are establishing correct control grouping, shape, size, motion, identification and frequency of operation. Levers and knobs are placed near the operator's hand on a pedestal or overarm. Less frequently used controls are on a support panel that, in many cases, can be closed and locked.

One or two companies are trying joystick controls like those on early airplanes, to combine two-dimensional operation in one control. Preselecting controls are gaining ground enabling the operator to set up an operation while a preceding one is going on.

Customers also insist on standards of safety and ease of maintenance for electrical and hydraulic systems.

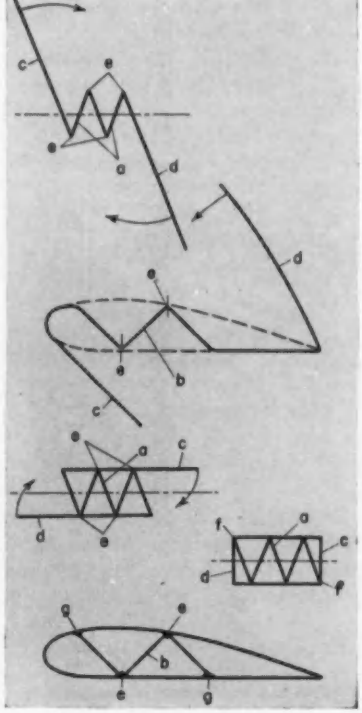
Speeds and Feeds

Higher speeds and feeds call for new tool materials and higher power. This means forced lubrication and serious study of antifriction bearings which are rapidly approaching their design limits. Look for air- or liquid-cooled bearings, a return to sleeve bearings, and further work in air-water-lubricated bearings.

Harder, tougher alloys, particularly for aircraft and missile work, have forced the development of specialty processes such as ultrasonic, spark-discharge, electrolytic and chemical machining. In some cases, spark-discharge heads have been mounted on standard machine tools. In other cases, close control of machining conditions has made present equipment suitable for the job, but the result will probably be special machines, designed for optimum machining of flimsy structures of the super-alloys.

Hollow Webbed Shape From Single Sheet

FRANKFURT, GERMANY—A new method for constructing hollow shapes with built-in stiffeners from a single sheet of steel has been patented by Dr. Edward Bruder, Frankfurt, Germany. The new technique requires that the webs or inner stiffenings (seen above in cross section) be used in a line of curves fitting inside the shape at flat angles. To produce the structure, the parts of webs a or *b* are bent. Then the free ends of the sheet are bent to provide an outer case over the webs. The outer case is then connected with the angle points of the enclosed webs at e, f, and g by welding or riveting.



Survey Points Up Poor Utilization of Engineers

LOS ANGELES, CAL.—That perennial controversy—how well industry uses its engineers— has come up for another examination, this time by four engineers. And they find that on the average an engineer or scientist in a Southern California electronics or aviation plant is used at less than 10% of his capability.

This study, *The Relation of Utilization to the Shortage of Scientists*, was made in fulfillment of a Masters degree for the Engineering Executive Program of the University of California. The four investigators are I. Hirsch, W. Milwitt, W. J. Oakes, and R. A. Pelton.

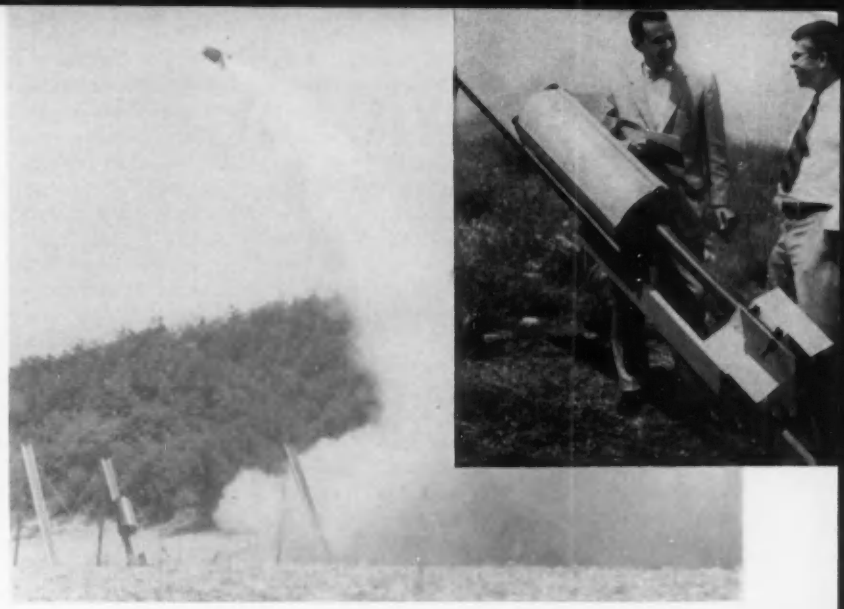
In defining their terms, the authors maintain "good utilization" presumes that scientific personnel be used in occupations suited to their ability and that make a useful contribution to society. Taking off from these premises, they queried 165 employees of companies, educational institutions, and consultants. They got 148 usable replies.

Replies showed that the average engineer and scientist feels he uses 21% of his time on activities suited to his unique abilities, 23% on routine or non-technical activities, and 56% on dubious activities such as writing reports, conferences, supervision, etc.

The authors add to this waste their estimates of loss from creative output incurred through engineers working on problems duplicated elsewhere, and from loss through turnover and working in poor physical surroundings. They conclude that useful employment of engineers and scientists actually accounts for only about 8% of working time.

Reasons behind poor utilization, the authors find, are many. The maddening pace of advance in knowledge in recent years makes it difficult for an engineer to keep abreast of developments even within a narrow specialty. Rapid expansion of engineering and scientific staffs has caused difficult problems of communication and control.

And they find that many government policies encourage duplication of effort. The "weapons system" concept causes overlapping of effort between prime and subcontractors.



FIRE! to Fight Fire

Another peacetime use for rocket power is demonstrated here by Grand Central Rocket Co. with its "Little Vanguard," a solid-propellant rocket used to fight forest fires. Measuring 54.5 in. in length, this rocket carries a payload of 8.5 gal of borate, water or other extinguisher with a 400 to 1200-yard range depending on number of motors used. With one motor it flies at 200 fps. Its prime function is to get into crevices, cliffs or ravines inaccessible to firefighters.

NATO Standardization Still Crawling

PARIS—Standardization of arms and equipment for the 15 member nations of NATO continues at a snail's pace despite the seven-year existence of NATO's Military Agency for Standardization.

Chief bottleneck is the millions of dollars' worth of material already produced by the substantial armament industries of the larger nations. Some of this might have to be scrapped if a piece of standard equipment were accepted. In addition, most of the military staffs involved have differing concepts of weapons values, and are reluctant to accept the views of other countries.

Take the Belgian .30-cal FN rifle, an automatic weapon called the T38 by our Army Ordnance. Standardized use of the Belgian FN was approved by MAS in 1954 and passed on to NATO governments for approval.

However, when the British government indicated agreement, bypassing its own EM. 2 rifle, the reaction in the House of Commons was tumultuous. Despite support from Winston Churchill, government efforts in behalf of the Belgian rifle were quashed.

Bowing to the inevitable, NATO permitted member nations to choose their own rifles, but pressed for standardized ammunition. On this point NATO achieved its only real arms standardization—agreement on the lightweight 7.62mm cartridge (.30 cal).

All NATO nations now use this cartridge except Iceland, Denmark and Luxembourg. Rifles still vary. In fact, Norway recently rebored all its rifles for the 7.62mm rifle rather than substitute the Belgian weapon.

Yet, acceptance of the 7.62mm cartridge was not gained easily. The British newspaper, Manchester *Guardian*, commented: "It was bad. The decision was dictated by the refusal of the US to consider retooling its factories in favor of the smaller caliber ammo (British .280 cal.), and by the insistence of the US that nothing less than the 7.62mm would have sufficient punch."

Best results in standardization have come in operations and administrative procedures. These stem from NATO war games where it was painfully apparent that, without standard operating procedures, NATO's military forces would be hopelessly ineffectual. For example, today all messages are radioed in English rather than the previous polyglot.

Other successes include standardizing such items as truck-tire sizes, refueling and servicing connections for aircraft and ships, and electrical-component sizes. This month a performance competition will be staged to determine which of several lightweight fighter planes will be accepted as standard equipment. The choice is between French and Italian equipment, both financed largely by the US. Whether the losing government will accept the NATO recommendation is something else again.

Although no official priority list for standardization exists, MAS officials give top billing to early-warning radar systems, followed by a long list of items that await approval of member governments.

Realistically, any agreement proposed by MAS is purely recommendation. A proposal is first considered by one of the MAS boards—Army, Navy, Air Force—which in turn appoints a working committee to investigate the matter. The board must then approve the working group's finding before the MAS committee passes judgment. After that, member governments receive the proposal and theirs is the final say. In the US, the Joint Chiefs of Staff decide. However, the US is more likely to seek approval rather than block it.

It is difficult to calculate the harm done by lack of standardization. It suffices to say that SHAPE officials continue to press for agreements.

On the other side of the Iron Curtain, such standardization is not a problem. If the Soviet military staff decides a particular make of rifle is to be used by all satellite countries, the Bulgarian army staff, for example, is hardly likely to demur. This, however, is enforced standardization.

Major Air Force Stretchouts Ended

LOS ANGELES, CAL.—The worst is over, as far as cancellations and stretchouts go. That is the picture as presented by Air Force Secretary Douglas, and Lt. General C. S. Irvine, Deputy Chief for Materiel in a recent Air Force procurement conference here. As a result, Southern Californians are feeling a little less in the dark about the future of aircraft and missile work. Douglas said that the recent Navaho cancellation and the impending selection between or merger of the Air Force Thor and the Army's Jupiter are the last cuts for some time in the development programs for long range delivery systems, including missile and large bombers.

However, the Air Force will stay within its budget, and will continue to examine every program and every dollar spent in the program. It boils down to this:

- There's going to be more competition, and it will be the company that can give the best for the least that gets the contracts.
- That's reflected directly in the thinking on subcontracting. The Air Force will continue to require primes to subcontract a substantial portion of their work to small businesses. But while the Air Force will resist the tendency of primes to pull in the work just for the sake of keeping their own facilities busy, it's not going to favor subcontracting for its own sake where it's uneconomical.
- The "make or buy" philosophy will be the guide—whether the prime does the work itself, or farms it out will be strictly a factor of economics.
- The Air Force is not in business to support the economy of a given segment of our population. That applies to geographic location too. Again, the company that can do the best job for the least money will get the contract regardless of location.
- Dispersal of production is a dead issue. This changes the attitude of several years ago when dispersal talk was big. The reasoning for the switch is that the dispersal policy was based on the assumed need for a big production build-up if a war should start. Therefore the production facilities would be harder to knock out. Sec. Douglas now says that if a war comes, it must be fought in the air with what we have when the war starts.
- The second-source policy is out too. Irvine says that the Air Force likes to have two sources during the research and development stages, but when it comes to production, we can't afford to have more than one.
- Overhead is going to come in for an investigation. The Air Force is going to expect contractors to hold down front office costs, excess manufacturing and engineering space and personnel, unnecessary premium-cost overtime, and plant operating expenses.
- The Air Force is going to expect "more pounds of hardware per laborer hour and more productive designs for each engineering hour. Irvine specifically mentioned in this case numerical and tape control of machines, and the use of electronic data processing.
- Irvine said that the Air Force is setting up procedures to control and forecast expenditures "right down to the plant, so that we will be able to determine trends, month by month, by contract and by company.
- If expenditures run higher than estimates, it will mean either reduction in quantity or cancellation.
- The Air Force is going to take a dim view of facilities expansion, although there will be necessarily some of it, but not where existing units can be utilized. One result of the move from manned aircraft to missiles—a reduction in the requirements for bay facilities.
- Irvine said that missiles would mean more, not less, employment per dollar expended. On the subject of the switch from manned aircraft to missiles, Douglas said that it was impossible to say how much and how fast. One thing though, manned aircraft will be with us for some time. General Irvine said that presently the weapons system dollar is going about 35-40% to missiles, but that in 15 years the figures might be reversed.

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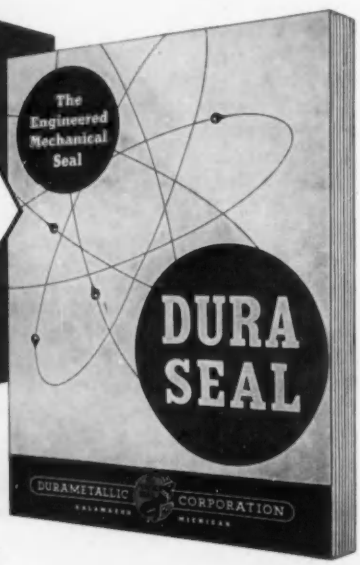

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Reverse Sabbatical Granted GE Scientist

SCHENECTADY, N. Y.—In continuance of a unique program, Dr. David Turnbull, manager of the chemical metallurgy section at GE Research Lab, recently went to England

for six months of studying and lecturing at Cambridge University's Cavendish Laboratory.

According to Guy Suits, GE vice president and director of research, this type of leave of absence gives his lab scientists the benefit of advanced study in their fields. The research leaves are comparable to university sabbaticals, but are not awards for years of service.

They were first granted two years ago when Dr. John C. Fisher of the lab staff spent the Fall semester at the University of California. Dr. John Kasper returned from a six-month stay at the Univ. of Bristol, Eng.

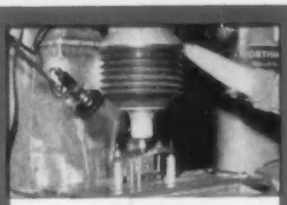
Dr. Turnbull, an authority on thermodynamics and solid-state kinetics, will be associated with Prof. Neville F. Mott, a British scientist.

Design Turnabout Saves Everyone Money

BUCYRUS, OHIO—Agreements to standardize on a limited number of types, sizes and tolerances of tapered roller bearings, made several years ago between Timken Roller Bearing Co. and its customers, has cut prices of the bearings concerned 15% below 1953 levels. (The objective is to cut conventional-method costs 25%.) The savings were made possible by a highly mechanized plant at Bucyrus, Ohio, which has been operating for several years, but has just been shown for the first time. It produces 33-million cups and 27-million cones a year, about 20 times as many as the Russian plant described in January of this year by *American Machinist*. Some 600 workers are employed in three shifts, producing 192 bearings per man per shift, contrasted with the Russian 30. Workers average only 29 years old, make $3.50 per hour with bonuses.

Most machine tools are special designs, some engineered by Timken, some by makers with Timken help and/or financing. Here, cooperative design has resulted in several developments in technique. Further details will appear in *Product Engineering* next week.

W. E. Umstattd, president of Timken, has announced that a similar line will be ready Jan. 1, 1958, at Columbus, Ohio, to make railroad journal bearings for freight cars. This represents the single largest potential for anti-friction bearings, because only 50,000 of the nation's 2-million freight cars now have anti-friction bearings.



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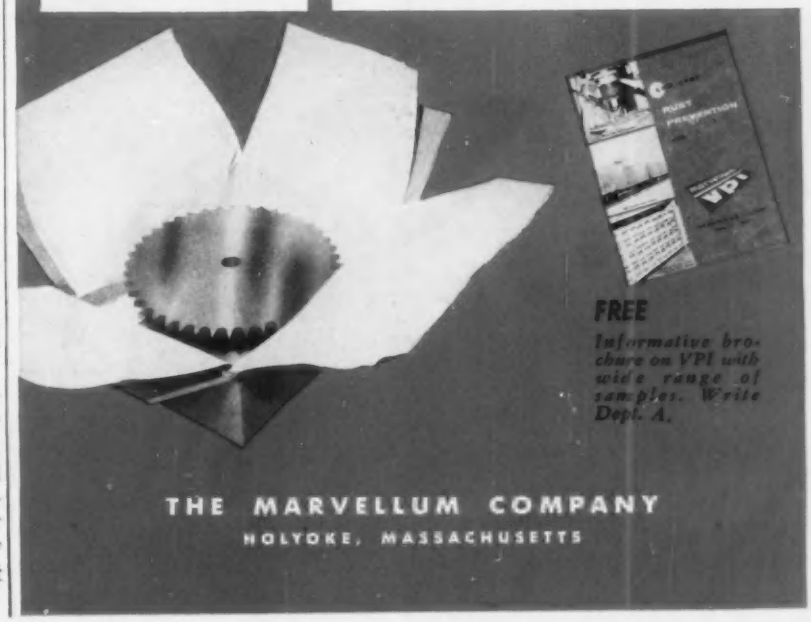

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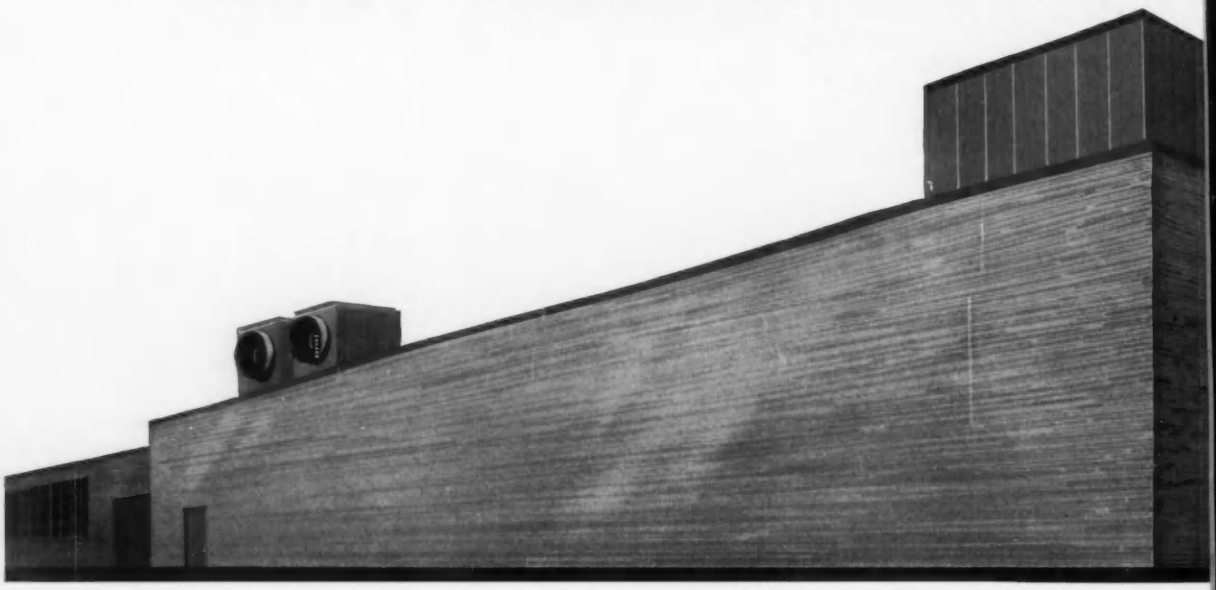

C/R's new Special Elastomer Section at Elgin, Illinois—just recently completed—was created to meet increasingly critical specifications for molded synthetic parts in guided missiles, jet aircraft, automobiles and industrial machines and equipment. There is no other comparable laboratory and production unit in the country.

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The new plant is specialized in the production of custom molded parts from Silicones, Kel-F Elastomers, the fluoro rubbers and Teflon*. Resistance to fuming nitric acid, resistance to temperatures of 600° F., or operation at – 400° F , and low coefficients of friction are just a few of the many special properties now available through these special materials.

To insure rigid, quality-control production under laboratory conditions, the plant was constructed *around* the laboratory. The entire manufacturing process, from origi-

Ovens, mill and press in the Laboratory Section. The entire production of Sirvene parts — from original research to final inspections—is in effect a laboratory process. From the original mixing, through the molding and forming processes and in all final tests, each step is scientifically controlled by Sirvene engineers.

The production process in miniature: The ingredients used to make up each specially formulated compound are carefully blended in the mill (center) to achieve a maximum of homogeniety. The batch is then sheeted out on the calendar (right) , or the compound is forced through the extruder. It's then cut into proper lengths for use in the press room, where it is molded according to rigid laboratory specifications.

Sirvene compounds based on

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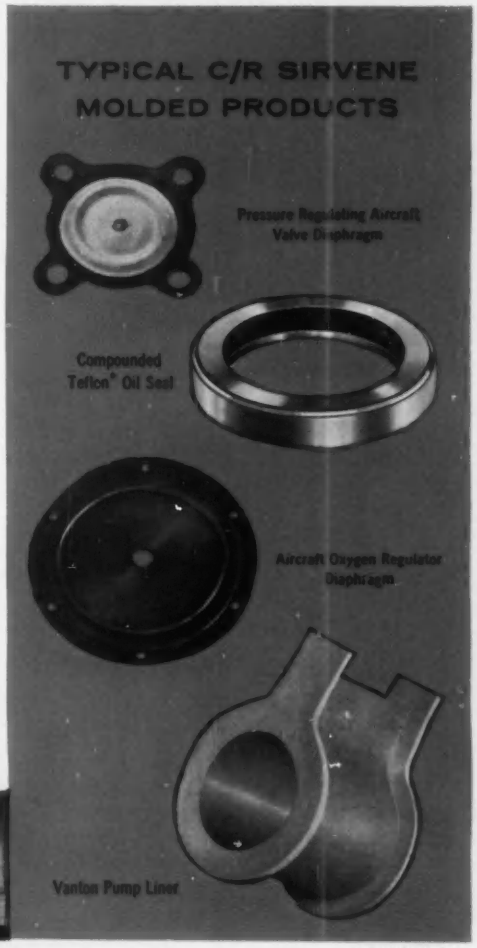

*DuPont Trademark

nal research to final inspection is a laboratory process. Such scientific control assures absolute uniformity in the dimension and quality of a product from the first to the fifty-thousandth part or more.

We invite you to investigate the ways in which C/R's Special Elastomer Section can serve you. Once the specifications and operating conditions for your particular product are defined, C/R engineers assume full responsibility—from design, compounding of the correct elastomer, through testing and quality control of production.

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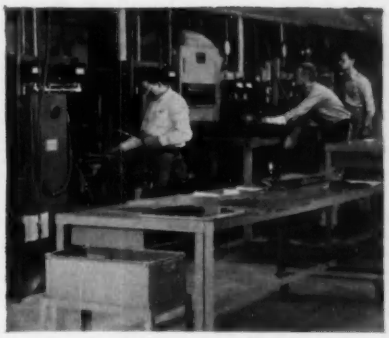

The Elastomer Section presses. Molds made with the greatest accuracy are placed into these automatically controlled curing presses. Here, the Sirvene part is then formed and cured for the pre-determined time and temperature.

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PAY NOW $ PROFIT LATER

FOR RESEARCH WITH NEW PRODUCTS

From 1953 to 1957, according to the latest McGraw-Hill survey of Business Plans, research expenditures nearly doubled. This year, they will total $7.3 billion. This is research conducted by private industry so presumably it will lead to new products and new capital expenditures by private industry. (While government assumes part of the costs on military projects, there are still substantial private expenditures.) But how much? And how soon?

A SLOW START

The impact of research is very gradual. Most companies report sharply boosted research expenditures, but only 32% of all manufacturing firms report significant capital outlays to make new products in 1957.

The reasons go back to some basic facts about research spending:

- Expenditures were relatively small until 1950.
- There is an average lag of at least 7 years from the start of research on a new product until the time the product is ready for large-scale output . . . perhaps 5 years of research, plus 2 years to develop markets (see chart).
- For such complex products as new machinery or new consumer durables, the time-lag may be even longer. So we are just beginning to see the results of a stepped-up research effort—and only in a few fields.

Research was relatively small until the Korean War brought substantial government contracts for research in aviation, electronics and related fields. There was also a sharp step-up at that time in research on atomic energy and its applications. The results of this 1950 upsurge are becoming apparent in 1957. Improved military aircraft (like the B-58 bomber, supersonic fighters and the first guided missiles) are in production. Commercial models of new planes and engines will be in airline service by 1958 or 1959.

When it comes to civilian products—for industry, or for the consumer—the upsurge in research spending is even more recent. Research has always been important in the chemical and electrical industries. This accounts for the steady flow of new plastics, drugs and synthetic fibers as well as many new electric and electronic devices. But for most companies that make non-electrical machinery, and in a wide range of consumer goods, heavy research spending did not begin until 1954. As late as 1953, research took only 1¢ per dollar of sales in industrial machinery, and only 0.2¢ in steel, compared to 3¢ in chemicals and electrical machinery.

Consequently, most improvements in capital goods during the past ten years have consisted of better machines (and better handling between machines), rather than revolutionary new processes. And very few consumer products have been completely new. Automatic transmission for cars, color TV, and "built-in" kitchen appliances are developments based on prewar research.

However, new developments are certainly underway. Research began to increase, in all lines of business, when Korean War restrictions and the excess profits tax came to an end in 1953. The tax revision of 1954 added a new incentive by making research outlays deductible as a current business expense. And by 1955, the research boom was on. Tax changes were not the only reason, of course. Business was getting more competitive, and new products were needed to spark sales.

From 1954 to 1956, research expenditures in manufacturing increased over 40%, with another 20% boost scheduled for 1957. Even allowing for increased costs of research (+5%/year, says the Bureau of Labor Statistics), industry is now working on more new products and new processes than at any time in history.

WHEN IS THE PAYOFF?

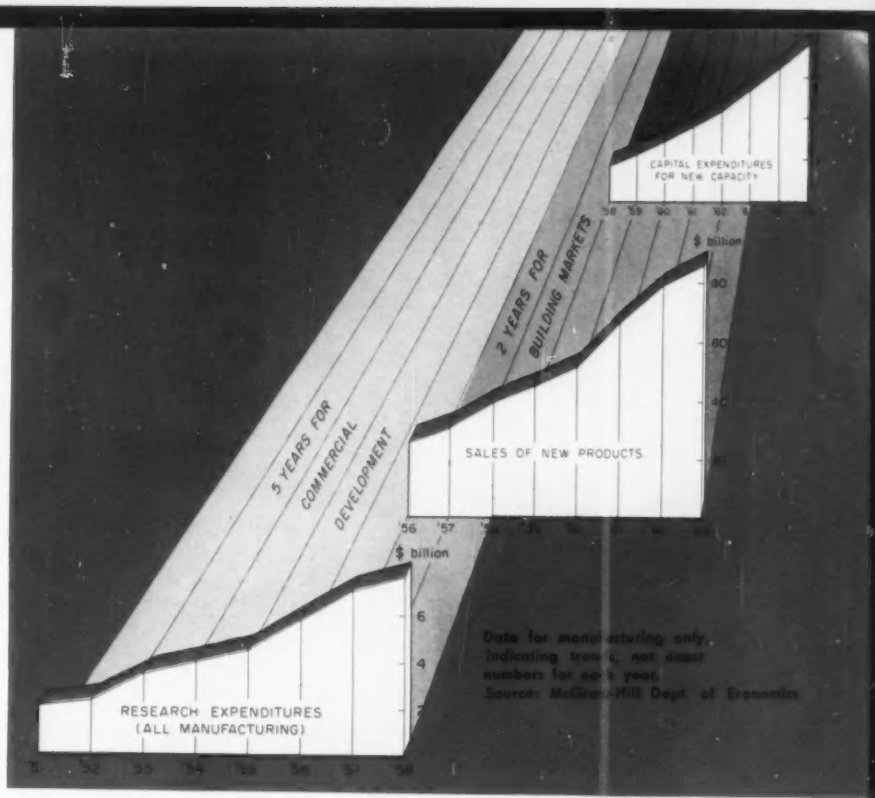
The results of this step-up in research activity will not be fully evident for several years. If the usual 7 year lag applies, then—remembering that research started to expand rapidly in 1955-56—it will be at least 1962-63 before the new developments become a dominant factor in capital expenditures. And it may be longer. But once this flow of new products starts, it will accelerate sharply—as research has been accelerating. And since research outlays are scheduled to increase further in 1957 and 1958, it seems clear that the effects of research will increase well into the middle or late 1960's.

The chart shows, in a general way, how the increase in research will lead to growth in sales of new products and capital spending to make new products. The projections are based on the idea that growth in new-product sales should parallel growth in research expenditures—but with a five-year lag. Capital spending to make new products should also follow—but with a longer lag, because it takes some growth in sales to justify really large-plant expenditures.

As shown on the chart, sales of new products will increase year by year. But they will gain most in 1960-62, or five years later than the 1955-57 spurt in research spending. The sharpest rise in capital expenditures to make new products comes even later—in 1962-64. This allows for a lag before the new items reach volume that calls for a significant amount of new capacity. And this

"Research and Development," as defined by the National Science Foundation in 1953, "includes basic and applied research and engineering, and also design and development of prototypes and processes. It does not include quality control, routine product testing market research, sales promotion, sales service, geological or geophysical exploration."

Research investment made today will not be repaid in products for 7 years or longer. The upsurge in research expenditures starting in 1955 won't appear in our homes until the early 60's.


CAPITAL EXPENDITURES FOR NEW CAPACITY
$ billion
2 YEARS FOR BUILDING MARKETS
5 YEARS FOR COMMERCIAL DEVELOPMENT
SALES OF NEW PRODUCTS
'56 '57
$ billion
RESEARCH EXPENDITURES (ALL MANUFACTURING)
Data for manufacturing only, indicating trends, not exact numbers for each year.
Source: McGraw-Hill Dept. of Economics

timing appears logical on other grounds. Population experts are forecasting another upsurge in marriage and birth rates around 1965. So by 1962, industry will be starting to build new plants for the growing markets of the mid-'60s—an expansion that will include many new products and new processes.

As we look at the rising curve of research expenditures, we can sum up the impact on business in this way:

1) New products will account for 13% of all manufacturers' sales by 1960, compared to roughly 8% in 1956. In dollar terms, they will mean $51 billion of extra sales by 1960—with a continuing increase to 1965.

2) Capital expenditures to make new products will total only $3 billion by 1960—but will reach $7.5 billion in 1965. They will increase from roughly 6% of manufacturers' capital outlays in 1956 to 17% in '60 and 30% in '65. And research will also mean larger outlays for replacement and modernization.

This would be a change in the main purpose of capital spending. If our chart is right, the proportions of capital spending would shift as follows:

Manufacturers' Capital Spending	*1956*	*1960*	*1965*
Expansion—old products	46%	30%	22%
Expansion—new products	6	17	30
Replacement and modernization	48	53	48

None of these figures is exact—or even close to exact. But they suggest the general trend.

The next question is: Which industries and products will be most affected by the coming upsurge in new products development? Here are some suggestions.

NEW MATERIALS AND COMPONENTS

During the next few years, we can expect an increasing flow of new materials, especially chemical materials, like the new plastics—for use in both consumer goods and capital goods. New metallic alloys, both steel and nonferrous, and combinations of metals with plastics or ceramics, will furnish additional materials for product design. There will also be many developments of new component parts for machinery and for consumer durable goods—especially electric and electronic components.

"New Products" are products sold in a given year that were not made 4 years earlier or products so completely changed as reasonably to be considered new products.

CONSUMER GOODS

Changes in materials and components will facilitate restyling of consumer products during the next few years. During these years (1957-61) we can expect a continuing stream of small improvements in consumer goods and great efforts to magnify these by advertising and sales effort. In industries where innovation is primarily a matter of style and service—packaged foods, apparel, autos and home furnishings—we may get the full impact of research during this period.

However, the really basic changes in consumer goods are further off. Things so new and different they would change the way a family lives—all-plastic houses, auto turbines, personal helicopters, wall-size TV screens or paper wearing apparel—are not coming until the mid-'60s, although all these products are under research and development right now.

CAPITAL GOODS

By 1959 or 1960, we should also begin to see a significant increase in capital spending for new machines, and improved versions of older machines, through redesign or addition of new components or control devices. The

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AMERICAN STOCK GEAR DIVISION

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Pay Now—Profit Later

(continued)

application of specialized computers to industrial-control problems is one example. Other possibilities are faster, more-compact machines, using improved motors and cutting tools, and more automatic transfer between machines. All of these ideas are already being used in spots, but in the next five years, application will become widespread.

The next five years (1957-1961) is too soon to expect the introduction of many new processes, in the sense of completely new ways to make things. Although much research is aimed at developing new processes, this is the type of research that takes longest to reach the commercial stage. Also a new process is usually devised as an economical way to add new capacity. And our present manufacturing capacity is relatively high compared to sales.

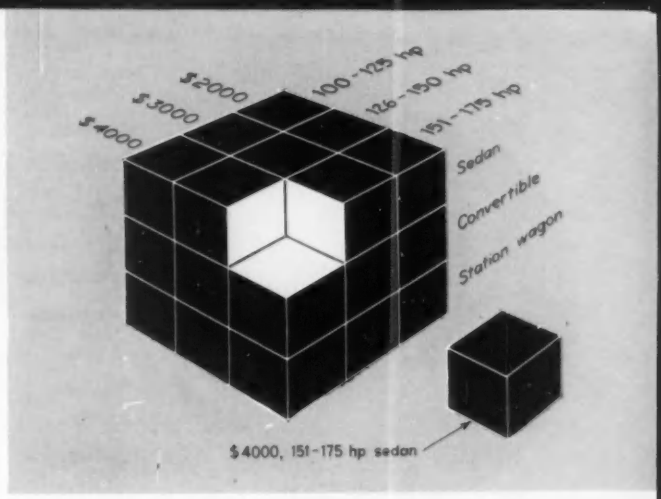
Sometime in the early '60s the consumer-goods industries will have to begin tooling up for mass output of their really new products. And then will begin the greatest capital-goods boom in history. For example, the huge automatic plants built to produce V-8 auto engines in 1954-55 will need new equipment by 1963 to start producing turbines in the mid-'60s.

NEW PROCESSES

In our heavy industries, it usually costs too much to introduce a new process as replacement. But it may be the least expensive way to achieve a large expansion of capacity. These industries are hoping to have new processes ready for the next great round of expansion. Some are so radical they require years of testing before adoption. But they may well be ready by 1965.

Thus, the auto industry hopes to have the truly automatic factory working at mass production of the turbine—with automatic machining, assembly and testing all controlled by computers. The steel industry is counting on continuous casting for the expansion of the mid-'60s. By then, the electric power industry hopes that a substantial number of its plants can be atom-fueled. The building industry hopes to use complete prefabrication techniques. And many metal products may be produced by direct reduction of ores, powder metallurgy and continuous casting techniques. END

HOW TO MAKE UP YOUR MIND



"Total think" is the name given by Dr. Fritz Zwicky, scientific advisor to Hycon Mfg. Co., to what he claims is a universal technique for solving problems. The system bears a strong resemblance to the theory of games of strategy, and is equally applicable to buying a new car (our example), choosing a direction for further research—or deciding on a dinner menu for the boss.

FIRST: Isolate the factors or areas of choice that influence the decision. Three factors might be all-important in buying a car: style, horsepower and price.

Note: In a simple game involving two persons, the factors would be limited to two: your strategy and your opponent's strategy. In a business decision the number of factors may seem endless: production cost, production quantity, selling price, product excellence, advertising influence, market attitude, political climate, etc. Simplification of these factors to a vital minimum is desirable if a definite decision must be made at once. But enumeration of all factors known to be influential may bring out relationships never before imagined.

SECOND: Isolate alternatives within each factor. Body style might be sedan, convertible, or station wagon. Market attitude might be favorable or unfavorable. Alternatives within a factor may be subdivided indefinitely (selling price: $4.50, $4.51, $4.52, etc.) but again it makes sense to reduce the number to a significant few to make the final solution a reasonable goal.

Now list the factors along the left edge of a page and the alternatives within each factor horizontally (See table below).

A table with three factors can also be conceived as a cube with each factor as one dimension and each choice a location along that dimension.

Any box in the cube represents a possible solution. (In illustration above, the removed box is a 151-175-hp sedan costing $4000; the 27 solutions represent all possible combinations of alternatives.)

Very often all combinations will not be possible—horsepower may be dependent on price and a $4000, 100-hp car not available. Elimination of some, or even most, of the combinations reduces total number of choices—but all that remain are practical solutions.

The arbitrary combination of all possible areas of choice may set up alternatives of decision never before considered practical.

THIRD: This step tells you which alternative is the optimum—if the problem is simple enough. If all factors are under your control, each combination of alternatives may be given an arbitrary value or estimate of desirability. The highest value combination is the logical choice if only one solution is permitted. But several interesting possibilities may be followed by different research staffs, for example, or you might simultaneously invest time or money in more than one business.

A variation on this method is based on game theory which, for all practical purposes, limits the number of factors (dimensions) to two and insists that while you have control of one, an opponent (Nature if need be) controls the second factor.

For Example: A research director must choose between two lines of work (see below). As far as he can tell they have equal chance of success. One is expensive but has great market potential, the second is cheap with poorer potential. The most conservative approach (always preferred by game theory) is to choose the solution that guarantees least loss—in this case the low research investment is called for.

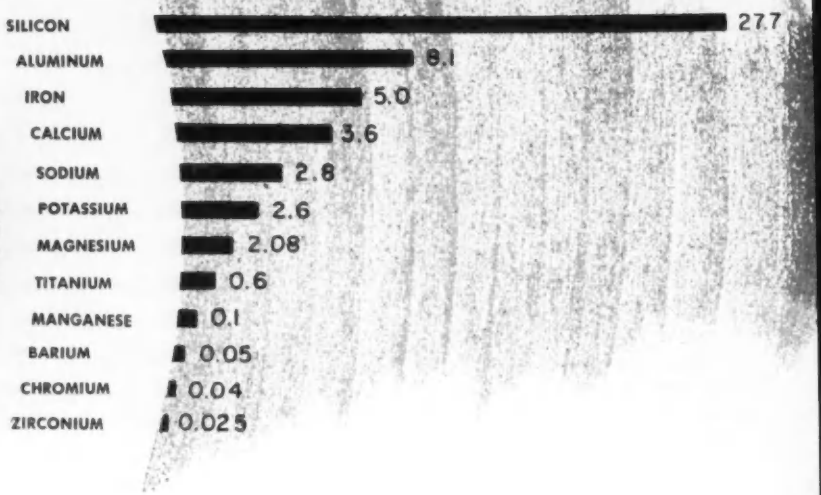
These problems have been simplified so that solutions appear almost at a glance. Solutions are possible by rigorous mathematical analysis for far more complex situations though they may call for computer aid in the rather repetitious calculations required.

But whatever the problem, and independent of any optimum solutions that may exist, it will always be helped by enforced clarification of issues inherent in game theory and "Total Think."

Factors			
Body Style	Sedan	Convertible	Station Wagon
Horsepower	100-125 hp	126-150 hp	151-175 hp
Price	$2000	$3000	$4000

Each chain is a problem solution.

		Success	Failure
Research Budget	High	+$100,000	−$10,000
	Low	+$20,000	−$1,000



Are we running out of

ERIC A. BRANDES
Fulmer Research Institute, Ltd., England

Metallurgists are concentrating heavily on higher temperature resistance, higher strength or lighter alloys. But is this enough? An alloy based on metals that will soon be unavailable—no matter how excellent its properties—can only be a temporary contribution.

Every substitution of silicon, aluminum or iron for a rarer metal is a triumph in conservation. These three top the list of metals in the earth's crust.

The most common metals (see chart above) will probably never be exhausted. To use even the plentiful metals, however, there is need for developing methods of processing low-grade ores (possibly even sea water) and providing more efficient reclamation of scrap.

Copper, tin, zinc, lead and nickel are firmly integrated into our way of life, but will gradually become more scarce. It is logical to re-examine the metals of the earth to see which we have in plenty and how they may be combined into alloys that will serve our future needs.

Silicon–Aluminum–Iron

Silicon is hardly a metal at all. Researchers have tried to produce ductile silicon, but this seems a forlorn hope. Silicon has, however, excellent alloying possibilities.

Aluminum is the most plentiful true metal in the earth's crust, but almost all aluminum is now extracted from one ore—bauxite. Poorer bauxites can be worked with blast furnace processes or, for low-grade ores high in silicon or clay, ore-smelting furnaces can reduce aluminous materials to silicon-aluminum or ferro-silicon-aluminum. A form of distillation is already in the pilot-plant stage for separating aluminum from the alloy.

Fortunately, iron exists in huge quantities in great ore bodies of high metal content. Yet, even here, rate of iron and steel production is so high that lower-grade ores must have serious consideration. In Britain the low-grade ores are worked by the basic Bessemer process, but a large amount of imported high-grade ore is used too.

It has been suggested that if an economic method were developed to work lacterite ore from Cuba and the Philippines for nickel and chromium, then a large new source of iron would be available as a by-product.

Iron, silicon, and aluminum may be put at the three corners of an illustrative triangle. Alloys of two elements are placed on the sides of the triangle (see top right). Distances parallel to the sides of the triangle represent the percentages of each element in the alloy. Combinations of all three fall within the triangle.

Aluminum alloys with 11% silicon are well established as castings and forgings; so are alloys with silicon and magnesium to make age-hardenable compositions based on the precipitation of Mg_2Si.

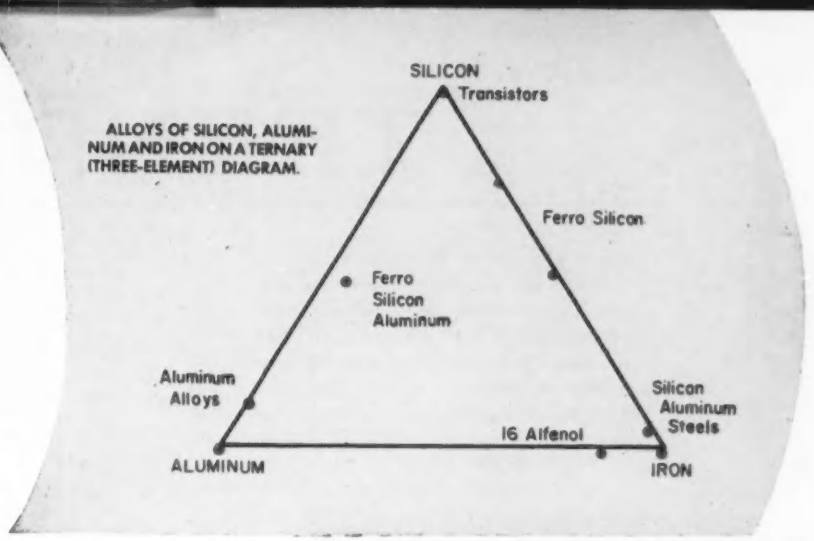
At the iron corner of this diagram, two new alloy types, the alumium-iron alloys with about 16% Al, and silicon-aluminum-steels with a combined silicon and aluminum content of about 7%, may yield materials with some of the desirable properties of stainless steels. This would conserve rarer metals like nickel.

Aluminum Steels

Good ductility of the aluminum steels requires vacuum or gas-atmosphere melting, but the 16% aluminum alloy has good oxidation resistance and corrosion resistance, and useful magnetic properties. A further alloy with 3% molybdenum added has high-temperature strength, is 20% lighter than stainless; has good oxidation resistance.

Silicon-aluminum Steels

Another series of lower alloys, under development at the Fulmer Research Institute, can be produced by steel-making methods. With 2½% silicon and 1% aluminum, a steel alloy is as oxidation resistant at 1650F as 18CR-8



ALLOYS OF SILICON, ALUMINUM AND IRON ON A TERNARY (THREE-ELEMENT) DIAGRAM.

metals?

Copper, tin, zinc and other familiar metals may soon be rare despite the availability of scrap and low-grade ores. But a dozen other metals are so plentiful we can use them as alloy bases, with the rarer metals as additives.

be increased without loss of oxidation resistance by alloying with molybdenum (yield strength—33,000 psi; ultimate strength—40,000 psi and elongation about 30% at 1100F).

Magnesium

Magnesium alloys are greatly strengthened by additions of grain-refining zirconium. Also, magnesium-lithium alloys (12% lithium) when alloyed with cadmium or zinc and some silver or copper, have ultimate strengths of over 40,000 psi with 10% elongation. However, the strength is produced by age hardening and any ambient temperature rise reduces strength.

Poor corrosion resistance is hampering widespread use of magnesium alloys. Overcome this drawback and we create a great new metal potential.

Titanium

So much has been written recently about this element that little need be added here. Titanium will become one of the great metals when production problems are solved. It could have great use in structures because of its corrosion resistance.

Titanium and its alloys are easily contaminated by oxygen and nitrogen at process temperatures, so that remelting scrap is an expensive operation involving special arc furnaces and careful attention to cleanliness. This makes scrap recovery barely economic at present. New processes would give great impetus to further application of the metal and it is likely that such methods could also be applied to zirconium and hafnium.

Chromium

Chromium-base alloys have good creep resistance up to 1800F at loads of 10,000 psi, but they are brittle at room temperature. Research into this characteristic may yet produce new ways to improve metals. It is still uncertain how much of this brittleness is intrinsic to the metal and how much is introduced by impurities. Nitrogen, even in very small amounts, apparently anchors at metal lattice dislocations, making them unavailable for slip processes that provide ductility. Heavy working seems to wrench the dislocation free. Test bars with as much as 40% elongation and a necked fracture have been made from pure swaged chromium. Annealing followed by recrystallization allows the locking process to be re-established, and brittleness returns. If further research can preserve this elusive ductility, chromium-base alloys might have a rosy future in the very high-temperature alloy field.

Calcium

As yet, no method has been found of making calcium oxidation-resistant. However calcium is light and ductile, and further research might produce a good structural material based on this metal.

Some Substitutions

Tin-aluminum alloys with about 30% tin can replace tin-base babbitt metals in motor-car bearings, with considerable savings in tin. Aluminum alloys are substituting for brass and zinc, and can also replace copper for many electrical purposes. Aluminum-alloy cable reinforced with a steel core is now common for overhead electrical cables. Steels highly strengthened by small quantities of boron (10 to 60 parts per million) are saving rarer alloying additives. A steel containing only molybdenum and boron as additions has good strength at 900F and excellent welding properties.

High-chromium iron is being used for resistance windings and some of the alloy steels are competing strongly with nickel- and cobalt-base high-temperature superalloys.

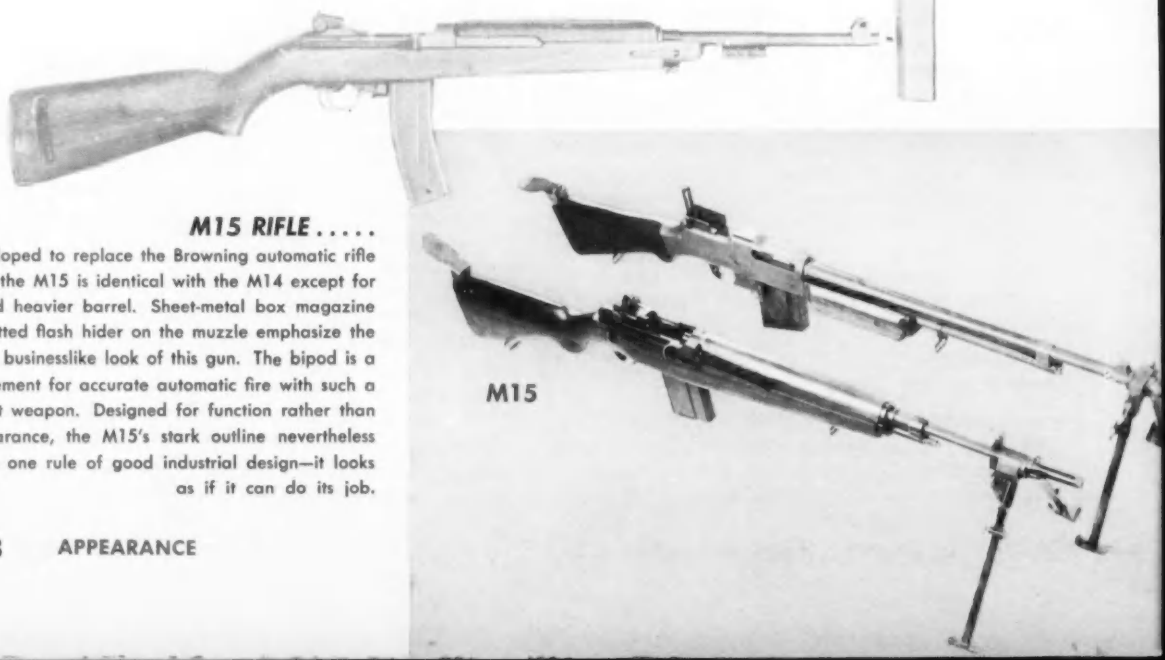
To conserve present metal supplies is only good husbandry. A research institute entirely devoted to the conservation of world metal resources and the development of our plentiful metals would be a worthy investment.

TRENDS

New US Army Weapons . . . . .

M14 rifle, now adopted after extensive tests, will replace three weapons (below) M1 rifle (Garand), M3 submachine gun, and .30-cal. carbine. New NATO cartridge permits the use of a shorter receiver, reducing the weight of the rifle. The M14 weighs ½ lb less although its magazine holds 12 cartridges more than the Garand. Automatic or semi-automatic fire can be selected by change lever.

M14



M15

M15 RIFLE . . . . .

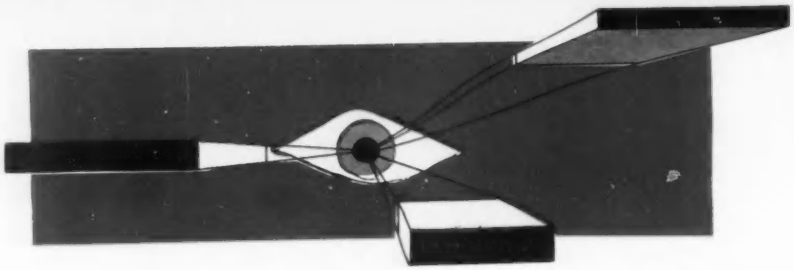
Developed to replace the Browning automatic rifle (right), the M15 is identical with the M14 except for bipod and heavier barrel. Sheet-metal box magazine and slotted flash hider on the muzzle emphasize the businesslike look of this gun. The bipod is a requirement for accurate automatic fire with such a light weapon. Designed for function rather than appearance, the M15's stark outline nevertheless fullfills one rule of good industrial design—it looks as if it can do its job.

in appearance design...

M60 General-purpose Machine Gun .....

Unadorned functional appearance reflects revised military thinking about automatic weapons. Designed as a machine to do a specific job this weapon bears little resemblance to the guns to replaces (right). Sheet-metal stampings and plastics instead of machined parts and wood accentuate the difference between the M60 and traditional weapons. When used on a tripod (below) the folded legs of the bipod provide additional cooling area for the barrel. A cartridge is the only tool needed for disassembly.

M60



POINTS

THE QUESTION: **How do you market-test a new product without giving sample products away?**

"As a producer of consumer durables...

we perform all-out market tests with regular prices, standard discounts, and controlled promotion. Our actual market testing, however, starts as soon as the new product idea is approved for development. Thus, we guide the product's development and design through research covering the needs and desires of the user.

"When the product is available in finished form, we have found that our previous assumptions and data usually receive their most accurate check from the retailer. If the product is fairly standard, such as a new bicycle design, a formal test marketing program in selected areas with before-and-after interviewing of test dealers is usually most productive.

"If the product is somewhat special, such as a new attachment for our DeWalt Radial Arm Saw, the personalized opinions and sales experience of a cooperating retailer panel are used to give us the confirmation or point up the potential trouble spots we are looking for in our test."

J. B. DABNEY,
Director of Marketing,
American Machine & Foundry Co.

W. W. MORRIS,
Director of Market Research,
Westinghouse Electric Corp.

"With an industrial product or heavy equipment . . .

it is best to work with one participating customer or with a division within your own company that has a definite need for the new product. After the product receives stringent factory testing, it is carefully scrutinized and proved under actual operating conditions. When all of the results have proved to be satisfactory, it is then offered to the open market with the backup data that has been gathered under actual operating conditions. If the item happens to be a small consumer item, such as an iron, toaster or coffee maker, then a consumer control panel of 25 to 50 people is given the product to obtain their reaction as to use, performance and other relative information. From such a small sample, it would be impossible to obtain a complete all-inclusive picture, but you should be able to get any glaring weakness that might have been overlooked by the development people."

OF VIEW

W. F. JOHNSON,
Director of Sales,
Consolidated Electrodynamics Corp.

"Establish the design of a new product...

then run a pilot of several prototypes. At this point we look for customers who have a need and an incentive. It is important that this customer be someone close to home, for economical servicing, and for ease in keeping on top of the situation. This then, is the customer who gets the prototype. It is sold to him with the understanding that we will work with him to get the 'bugs' out, and that the product will eventually be modified to include improvements.

"At the plant, engineering has built a 'cake board' and Lot 1 goes into production. If all goes well, feedback from evaluations of the prototypes comes in and improvements are plugged into the production models. This is a continuing process for Lot 1—it should be completed before Lot 2 goes into production."

This procedure has been carried out recently with our Analytical and Control Div's Process Chromatograph. The procedure has been used for items as large as our MilliSADIC Data Processing System (installed at a missile data-reduction center) and as small as the pickups manufactured by our Transducer Div. The test is considered valid when the hand-picked customers are happy. After all, they represent the major market for our specialized instruments.

C. A. PETERSON,
Director of Quality Control Engineer,
McCulloch Motors Corp.

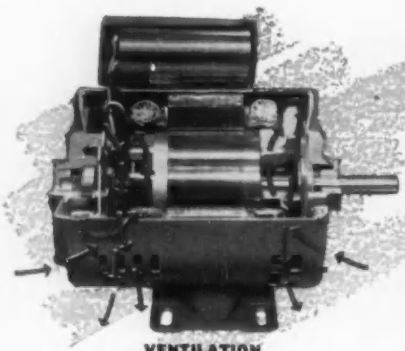
"Market Testing is the final check . . .

in our product engineering program. We know that our competitors are going to examine our test units, which are sent out through regular distributor channels, but we also know that there is so much lead time in the manufacture of gasoline powered equipment that our competitive position is not jeopardized. Our advertising department and sales force are already putting campaigns into operation to take advantage of our design improvements.

"Prior to this, we have already decided to manufacture the product, build and test prototypes, and make a pilot production run. The pilot units have been field and laboratory tested by our Product Engineering Group who have subjected them to every possible condition of use and abuse. Modifications suggested during this program have already been made. A survey form is sent to our distributors along with the test units which are loaned to customers to obtain information that is used as a guide for last-minute design changes and in the planning of our marketing campaign."

available in . . .
SPLIT PHASE,
PERMANENT SPLIT CAPACITOR,
CAPACITOR START-INDUCTION RUN,
POLYPHASE

NEW!



VENTILATION

CLEAN, MODERN DESIGN—Lightweight, die-cast aluminum head ends accurately fit precision machined steel body, assuring rigidity and good alignment. External finish is smooth, flow-free . . . blends well with any color.

IMPROVED, DOUBLE-END VENTILATION—Ventilating fans are integral with die-cast aluminum squirrel cage rotor, providing effective cooling of the windings from both ends for long life. Properly located openings give maximum cooling with minimum internal parts exposure.

MYLAR* POSITIVE INSULATION—Mylar* polyester film laminated to rag paper insulates slot cells and other strategic areas. Excellent dielectric qualities and resistance to tearing and aging, affording virtually permanent protection against dust, moisture and heat damage.

CHOICE OF MOUNTINGS, BEARINGS—Rigid, welded base or vibrationless, ultra-quiet resilient mounting with motor hubs floating on rubber cushioning rings permanently bonded to inner and outer metal bands. Either sleeve type or fully sealed ball bearings available. If desired, special construction permits re-lubrication of ball bearings. Bearings seat in precision bored steel rings cast into the aluminum heads.

**DuPont registered trademark*

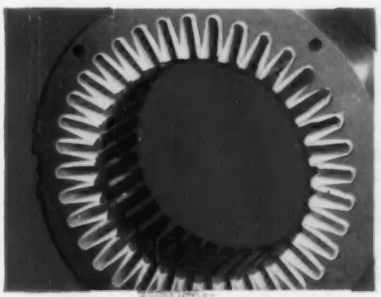
Robbins & Myers build motors from 1/200 to 200 horsepower

R&M

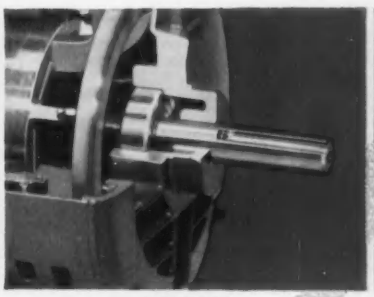
R & M's BROAD LINE OF SMALLER, LIGHTER, FRACTIONAL HP MOTORS

Robbins & Myers Re-Rated Frames 56 and 48

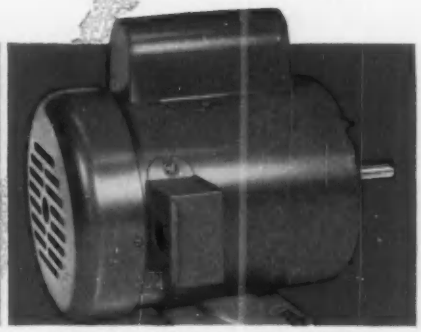
Here's a dynamic new motor—smaller, lighter, more versatile than older frame motors—yet with undiminished performance and reserve power. Completely new R&M "Model R" fractional horsepower motors will perform dependably and enhance the appearance and acceptability of your products. They range from 1 to ⅛ HP in types for all your applications: polyphase, permanent split capacitor, capacitor start single phase and (in the smaller ranges) split phase types. Designed in new NEMA frames 56 and 48, they are *lighter* due to new applications of aluminum, steel and copper . . . *smaller* thanks largely to a unique new ventilating system . . . *more versatile* because of weight, size and many other design features involving frames, mountings, insulation etc. Look over the big advantages these motors offer you! Then write today for R&M Bulletin No. 450–PE.



MYLAR SLOT CELL INSULATION



BEARINGS



TOTALLY ENCLOSED—FAN COOLED

ROBBINS & MYERS, INC.

SPRINGFIELD, OHIO | BRANTFORD, ONTARIO

MOTORS

FANS

HOISTS

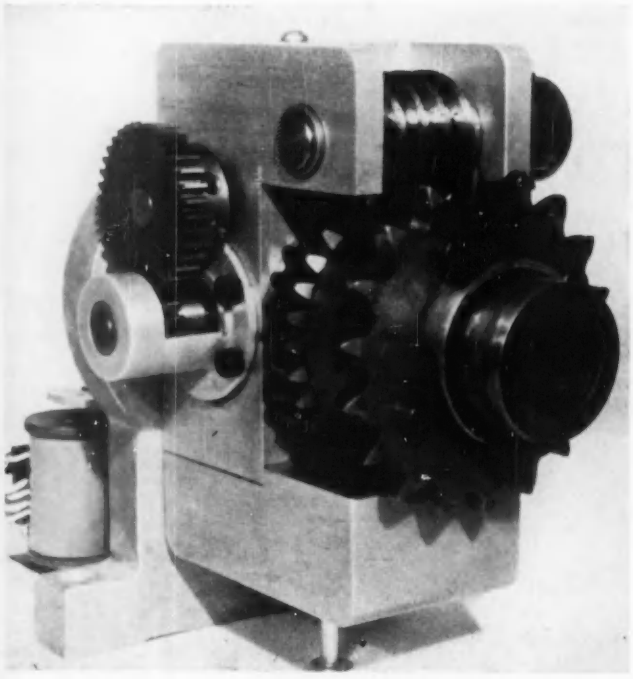
MOYNO PUMPS

PROPELLAIR FANS

SIGNIFICANT PARTS

500-F adhesive for stainless steel . . .

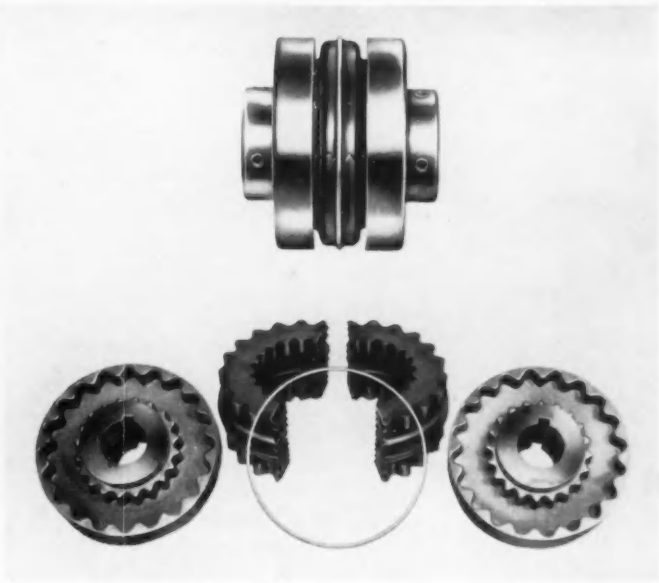
can be used for regular metal-to-metal as well as for honeycomb sandwich constructions. As an alternative to brazing, this modified epoxide resin eliminates expensive tooling and alloys. Lap shear strengths range from 1400 to 1750 psi, depending on curing time (4½ hr); flexural beam strength runs from 1400 to 1500 lb for honeycomb structures (priming time, 2 hr; curing, 4½ hr). Adhesive is applied in tape form to metal-to-metal assemblies; primer is also required for honeycombs. Experimental quantities available. Rubber and Asbestos Corp., 225 Belleville Ave., Bloomfield, N. J.



Electro-mechanical compensator . . .

synchronizes rolls, drums, belts, indexing devices or other units of packaging, printing, materials handling, textile or paper machinery in less than 1/20 sec after starting or stopping. The device mounts directly on the shaft to be controlled, providing as much as 2% addition or subtraction of rotary speed. The compensator can be applied to shafts running as fast as 600 rpm and can be controlled either manually or automatically. Price, $400; delivery from stock. Mackenzie Products Co., 11 E. Wesley St., S. Hackensack, N. J.

MATERIALS · EQUIPMENT

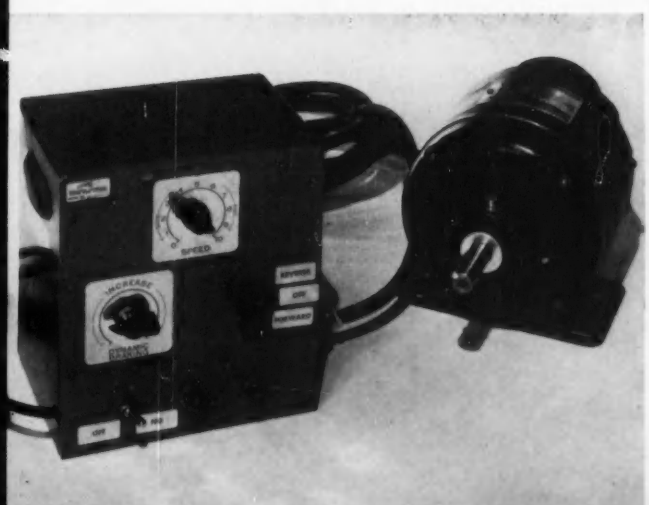


Sleeve and flanges make flexible coupling . . .

that is installed by sliding together on shafts to be connected, placing retaining ring and tightening setscrews. There are both internal and external teeth on the flexible rubber sleeve, which mate with teeth on keyed metal flanges. Shock and vibration are said to be absorbed without generation of imbalance or pulsations in driven shaft or unit. Couplings have handled, without appreciable wear, angular misalignment up to 1°, parallel misalignment of $\frac{1}{32}$ to $\frac{1}{16}$ in., end-float up to $\frac{1}{8}$ in. Available are six sizes for motors of 3 to 80 hp, shaft bores $\frac{3}{8}$ to $2\frac{1}{4}$ in. Available from stock beginning Oct.; price, $12 to $40, depending on rating. T. B. Wood's Sons Co., Chambersburg, Penn.

Heat, load, speed, flow . . .

can be controlled by this electronic device by inserting a curve drawn on transparent graph paper in the slot in the front panel. This positions the curve before a scanning tube. A photomultiplier circuit varies pulse width in accordance with height of the curve. Can be used with either a-c or d-c equipment. A camera for making graph transparencies is available. Price, $1500 for scanner alone; delivery about 3 mo. Spar Engineering & Development, Inc., Paxson and South Ave., Wyncote, Penn.



Speed control with adjustable braking . . .

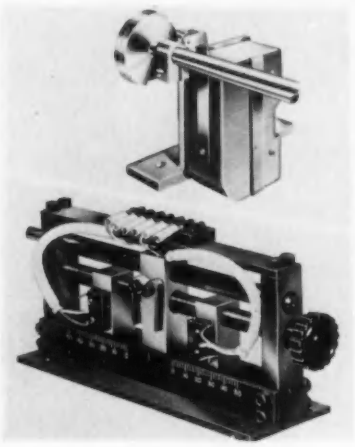
is available for any shunt or compound d-c motor of up to 3 hp. Speed is electronically controlled in either direction from zero to full load, and is maintained regardless of line voltage (117 v ac supply) variations are great as 20%. Braking is electromagnetic and speed of application is adjustable—by changing amount of current and direction of application to motor winding. Suggested for applications where variable speed with constant torque is required. Delivery in 30 days; price, $150 without motor. B & B Co., 3124 E. 14 St., Oakland. Calif.

Any two out of three events . . .

happening together will energize this coincidence relay, providing actuation of a combination of machine operations or fail-safe monitoring for signal or alarm purposes. The device resets itself when all three circuits are back in normal position. Measures 1⅞ x 2 x 3¼ in. high and weighs 15 oz. Has a double-pole, double-throw contact arrangement rated at 10 amp; 115 v ac. Delivery in about 30 days. Price is $24. Certi-Fact Engineering, Inc., P.O. Box 774, Sherman Oaks, Calif.

Electric predetermining counter . . .

with automatic reset has five control knobs which can establish control points at any of 10,000 possible digital count combinations. Electromagnetic counting units permit use of a variety of remote actuators. Electric reset 2-sec deviation permits automatic recycling, automatic reset, or push-button reset. Counting speed is 600 counts per min, max. Operates on 115 v ac, 50-60 cps; consumes 10 w max. Measures 9 x 10 x 5½ in. Price, $275; delivery about 5-6 wk. Veeder-Root, Inc., Electronic Control Div., Hartford 2, Conn.

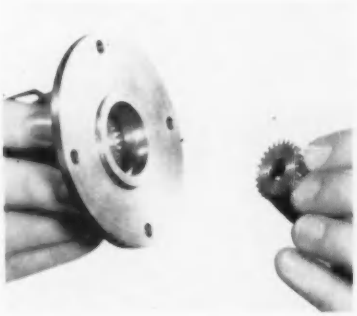


Two types of limit stop devices . . .

control mechanical or electromechanical functions. A cam-operated actuating or limiting device consists of a single-pole, double-throw microswitch and two adjustable matching cams that can be preset to provide circuit make-or-break points over any desired rotational arc. Cam assemblies are available to cover a combined range in degrees of valley of either 0 —180° or 180 —270°. The second device is designed for electrical and mechanical stop operation by de-energizing the driving motor just before the mechanical limit is reached. Manually adjustable between 1 and 100 revolutions of the input shaft, stop positions are indicated on a large, direct-reading scale. Ready for stock delivery. Helipot Corp., Div. of Beckman Instruments, Inc., Newport Beach, Calif.

Thin metal parts without dies . . .

developed for structural parts of planes flying 2700 mph is of the precipitation-hardening type. One set of specimens of this new alloy, annealed before forming and later subjected to a two-step heat treating, exhibited a 135,000-psi tensile strength at 1000 F (room temperature strength, 240,000 psi). Available as sheet, strip, foil, plate, bar, wire, forgings, Armco Steel Corp., Middletown, Ohio.

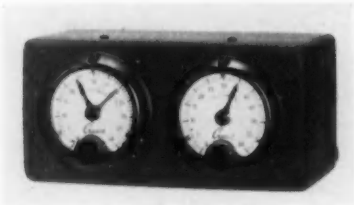


Miniature magnetic brakes . . .

have metallic bonded friction linings. Magnetically released, spring-set brakes are designed to operate on 28 v, dc. Torque rating is 25 oz-in. on consumption of 4.9 w. Dimensions are 1⅞ x 2 in. long. Weight is a little over 8½ oz. Stearns Electric Corp., 120 N. Broadway, Milwaukee 2, Wis.

Two-wire thermal switch . . .

uses a bimetal element and stainless steel body. Operates in ambient temperatures from —65 F to 700 F, factory set and hermetically sealed. Electrical rating is 2 amp resistive at 28 v dc or 115 v ac Length over AN connector is 2⅞ in. Designed to meet applicable military specifications. 306 Sussex St., Harrison, N. J.

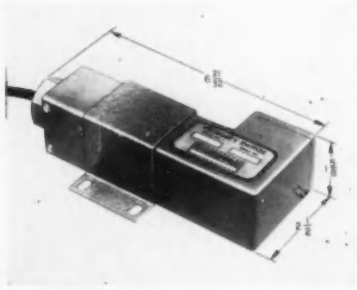


Duplex cycling timer . . .

can control the operation of process work equipment, regulate both idle and operating time on a wide variety of production machinery, or perform a large number of in-plant functions automatically. Two standard, motor-driven automatic reset timers are used. Each load switch operates within a repeat accuracy of 0.25% of scale reading and is rated at 15 amp, 125 v, non-inductive. Rated for operation on 115 v or 220 v ac or dc, 60 or 50 cps. Adjustment of each timer is independent of the other. Standard time ranges list 11 choices from 6 sec to 24 hr, offering more than 60 possible timer combinations. In a 9⅛ x 4½ x 5 in. housing. Cramer Controls Corp., Centerbrook, Conn.

Vernier potentiometer . . .

may be used as either a potentiometer or rheostat without modification, and is available in standard resistance values of 1,000, 10,000 and 100,000 ohm. Full-scale resistance accuracy is ±0.1%; linearity is ±0.1%; resolution is 0.02% or better; power rating is 3 w max when used as potentiometer and 20 milliamp when used as rheostat. Construction requires only two turns of the control knob to cover the full scale of two resistance decades, which provide range and resolution equal to a conventional 10-turn helical potentiometer. Wire-wound resistors are used in both resistance decades, one consisting of fixed resistors connected to a rotary switch and the other of a single-turn interpolating potentiometer. Mounts as a complete unit similar to a conventional panel meter and requires no disassembly or removing of dials. Requires 2 x 2 in. panel space and projects 3 in. behind the panel. Research Instrument Corp., 7962 S. E. Powell Blvd., Portland 16, Ore.



Proximity switch . . .

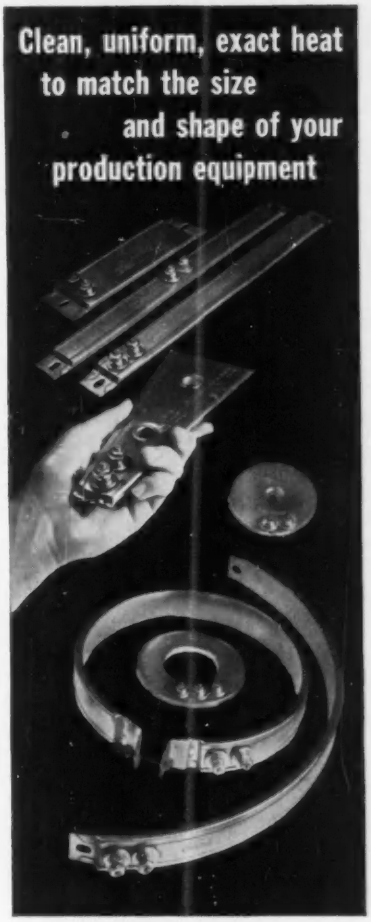
can be mounted on a surface that extends only 3¼ in. from the material that operates it. Switches are static, for use in detecting a ferro-magnetic object without direct contact. The unit cannot be set in action accidentally by ferrous chips. An adjustable mounting bracket is furnished. Excitation is 100-125 v, 60 cps, 2 w (nominal). Output for 'on' is 12v dc min into 250 ohm load for 'off', 4 v dc max into 250 ohm load. Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.

Variable-speed controller . . .

regulates a standard, wound-rotor, a-c motor. Full-rated motor torque is achieved at all speeds without exceeding rated rotor or stator currents. Using a d-c tachometer generator for feedback of motor speed, regulation of ±1% over a speed range of 1050 to 1530 rpm is obtained via magnetic amplifiers in series with rotor-resistant resistors. Operating frequency of the controller can be preset or adjusted while running. Selected frequency can be read from a large indicating dial on the hinged controller door. Contained in a louvered metal cabinet that measures 51 in. high x 24¾ in. wide x 21 deep. May be located remote from either the set it directly controls or the end device it indirectly controls. Input and output connections are made at the bottom of the control panel. Warren Mfg. Co., Littleton, Mass.

Teflon tape in colors . . .

in thickness of 0.001 through 0.125 in. is reported to have been processed with excellent retention of basic Teflon properties. Tape meets military and NEMA specifications. Has a low dielectric constant of 2.0 and high volume resistivity of 10^{15} ohm-cm. It has a service temperature range of −320 F to 500 F, zero water absorption and is chemically inert. Polymer Corp. of Penn., 2140 Fairmont Ave., Reading, Penn.



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Quickly and easily bolt or clamp Chromalox Electric Strip Heaters to your platens, dies, kettles, tanks, pipes, ovens, air ducts, for the many advantages obtained only with electric heat.

Lengths 4" to 96" Widths ¼" to 2½"
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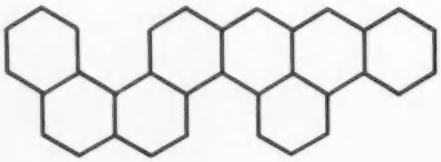


ANALYTICAL ENGINEERS

At Hawthorne, in Southern California, Northrop Aircraft has a continuing need for experienced engineers seeking new opportunities. There are attractive positions open in the following fields: Aerodynamics, Dynamics, Thermodynamics, Stress, Loads, Performance Analysis.

In Northrop's superbly equipped multi-million-dollar engineering and science center, now nearing completion, you will be given constantly fresh and challenging assignments. Present programs include Northrop's new supersonic trainer airplane, the Snark SM-62 intercontinental guided missile, plus advanced aircraft and missile projects yet to be revealed.

You'll be associated with a high-calibre engineering team that has established an outstanding record in aeronautical design and development. Your initiative and ideas will be recognized, encouraged and rewarded, for at Northrop Aircraft the progress of personnel is as important as the progress of projects.

Besides attractive remuneration, you will enjoy other benefits unexcelled in the entire industry—retirement plans, health and life insurance, college educational reimbursement plan, regular vacations plus extra year-end vacations with pay. Easily-reached mountain, desert and beach resorts in sunny Southern California offer year 'round attractions for you and your family.

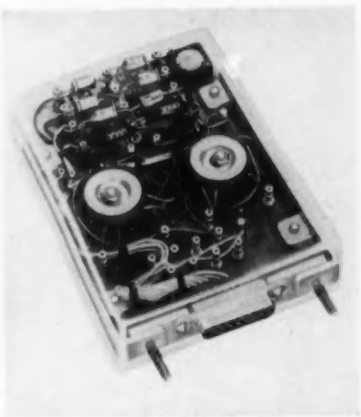
You will find the career opportunity you are seeking at Northrop, pioneer in the design and production of all weather and pilotless aircraft. If you qualify for one of these attractive positions, contact the Manager of Engineering Industrial Relations, Northrop Aircraft, Inc., ORegon 8-9111, Extension 1893, or write to: 1015 East Broadway, Department 4600-P, Hawthorne, California.

NORTHROP

NORTHROP AIRCRAFT, INC., HAWTHORNE, CALIFORNIA

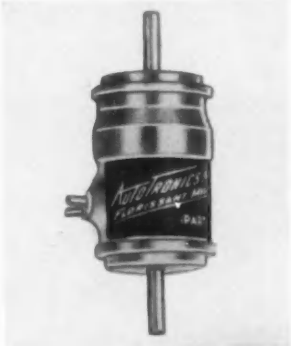
Producers of Scorpion F-89 Interceptors and Snark SM-62 Intercontinental Missiles

SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .



Magnetic amplifier for hydraulic valves . . .

achieves high gain and fast response by operating at a supply frequency of 5000 or 3600 cps. Suitable for controlling low power output devices. Supplied with dual input windings to facilitate signal mixing. Additional control windings can be furnished. Power supply required is 60 v; maximum power output is 0.2 w dc. Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y.



Subminiature electromagnetic brake . . .

is normally free running and the output shaft is braked when energized. Servo-mounted units are offered with the shaft out either or both ends. Controlled torque output under vibration meets military requirements. Units come in ratings of 6-100 v dc. In Model B-4, main brake torque is 4 oz-in. Overall dimensions are 0.594 in. dia x 0.93 in. long excluding output shaft. Weight is 0.75 oz. Autotronics, Inc., Route 1, Box 812, Florissant, Mo.

5-A-89

SIGNIFICANT PARTS
MATERIALS
EQUIPMENT . . .

Shaft angle converter . . .

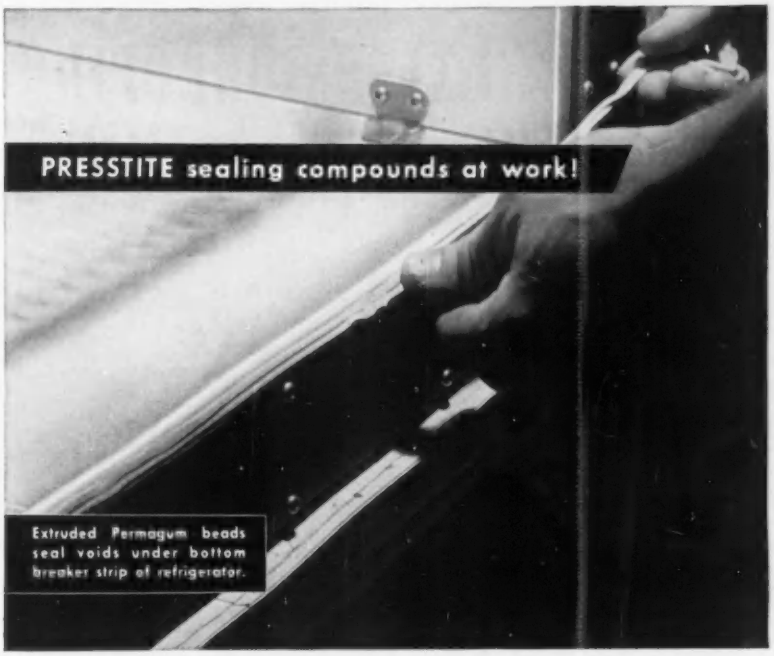
converts rotary motion into binary decimal readout of 1 in 3600 counts at 40 codes per revolution of the input shaft. For airborne, military or industrial applications. Special intermittent gearing and bearings result in low driving torque. Input shaft can rotate at speeds to 300 rpm in either direction. Code drum cylinder is 0.65 in. dia and approximately 1⅛ in. long. It is composed of an epoxy fiber glass tube with a 0.005 in. wall thickness copper tubing bonded to its outer surface. Fiber glass tubing is the mechanical method of supporting the code drum and a strong rigid member for translating motion to the first stage of gearing. Brushes are rated 40 v dc at 20 ma current and can operate directly into most associated circuit. Converter is 1.87 in. dia and 2.37 in. long. Weighs about 3 oz. Life expectancy is in excess of 1000 hr. Instrument Development Laboratories, Inc., 67 Mechanic St., Attleboro, Mass.

Teflon rods . . .

are available 0.200 to 2 in. dia as extruded and from 0.200 to 1 in. dia in centerless ground. United States Gasket Co., Camden 1, N. J.

Flexible gear belt . . .

has small molded teeth that mesh with corresponding teeth on small-diameter pulleys. Shear strength of the 40 diametral pitch is said to exceed 50 lb./in. of width. Suitable for use with sound and data recorders, instrumentation, control knobs and high-speed grinders requiring high speed step-up or maximum traction. Also available with 120 diametral pitch teeth. Russell Mfg. Co., 388 E. Main St., Middletown, Conn.



refrigerators and freezers sealed with **PRESSTITE PERMAGUMS®** *stay drier and colder*

Where effective, permanent sealing is a factor, Presstite's many types of Permagums may be perfectly adapted to the need. They are used extensively, for example, in a wide range of refrigerator applications.

Permagums offer unusual and outstanding characteristics:

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- non-corrosive to all metals.
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- unaffected by temperatures ranging as low as —30°F. to as high as 400°F.
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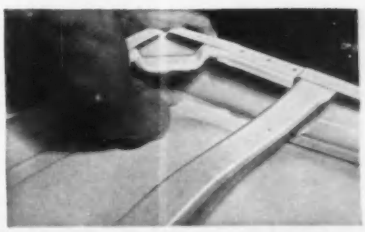

Bulk Permagum thumbed into irregular gaps in freezer door.

WRITE TODAY. Describe your sealing application and we will gladly send samples, data and prices.

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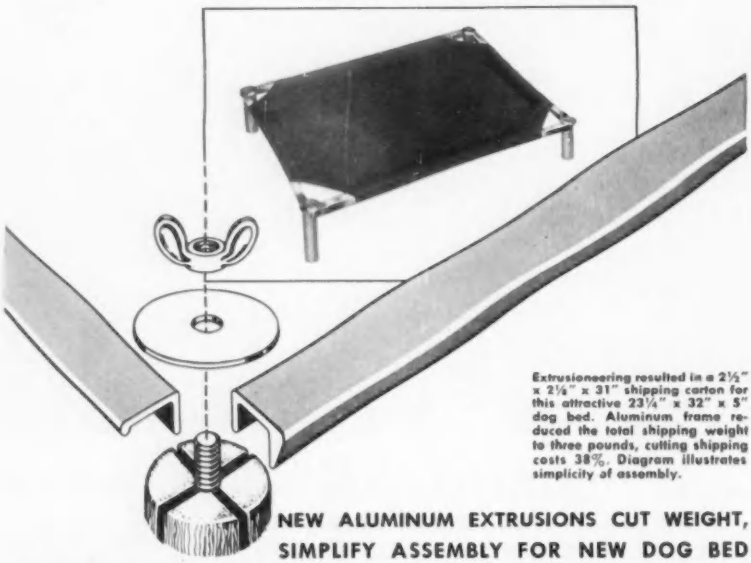
How PE Extrusioneering

AND SKILLFUL DESIGNING SOLVED NEW PRODUCT PROBLEM



Extrusioneering resulted in a 2½" x 2⅛" x 31" shipping carton for this attractive 23¼" x 32" x 5" dog bed. Aluminum frame reduced the total shipping weight to three pounds, cutting shipping costs 38%. Diagram illustrates simplicity of assembly.

NEW ALUMINUM EXTRUSIONS CUT WEIGHT, SIMPLIFY ASSEMBLY FOR NEW DOG BED

Here is another example of how PE Extrusioneering has helped make possible the profitable production of a new product—this time for Proven Products, Evanston, Illinois, well-known manufacturer of advertising specialties. Original projected costs made the attractive new dog bed impractical. PE Extrusioneering was called into action and special new extruded shapes were developed to meet product requirements.

The new aluminum extrusion resulted in several direct benefits over the original steel frame: (a) elimination of treating and painting expense to resist corrosion; (b) simplified assembly which resulted in a more compact package; (c) reduced weight, and a 38% reduction in shipping costs; (d) a more attractive finished appearance.

Perhaps you can benefit from Extrusioneering, also. Ask for a PE engineer to work with you to help solve problems on your new or revised designs.

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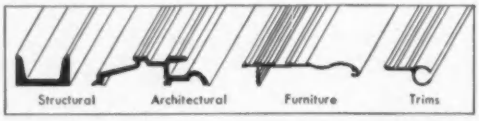
2. SPECIAL SHAPES—experienced engineering, design, and die service to help you avoid costly fabricating and assembling problems.

3. NON-COMPETITIVE MILL SERVICE—devoted exclusively to producing aluminum extrusions only. We do not fabricate or manufacture other products.

4. COMPLETE FACILITIES—die making, billet casting, various size extrusion presses for efficient production, scientific quality controls, and standard finishing operations.

5. PROMPT PERSONALIZED SERVICE—trained personnel to handle your inquiry and follow through on your order.



WRITE FOR FREE CASE STUDIES

New bulletins, "PE Extrusioneering News," illustrate cost-cutting solutions to various design problems, give helpful technical and fabricating data.

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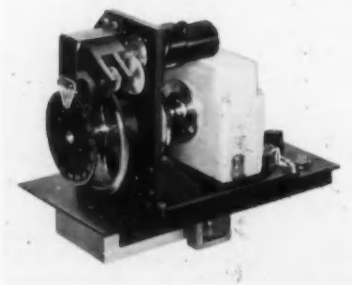
is used to log total hours of machine or equipment operation. Particularly suitable for panel mounting. Has square white face dial with black figures. Available in 120 v, 480 v; 50 or 60 cps. John W. Hobbs Corp., Springfield, Ill.



Servo-driven digitizer . . .

converts an a-c input signal into a binary-decimal output. Encoder shaft is driven ±170° from null. Full scale corresponds to 10 v rms, 400 cps, in phase with the line. Static error is 0.15% of full scale and fast rates can be followed with a velocity error constant of 500 sec^{-1}. Packaged for inclusion in larger equipment. Industrial Control Co., 805 Albin Ave., Lindenhurst, L. I.

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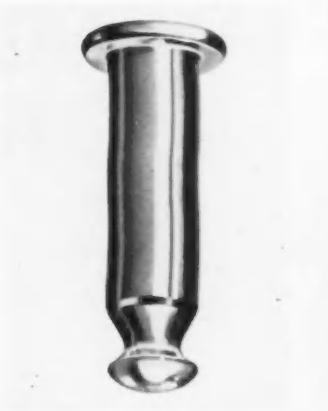
SIGNIFICANT PARTS
MATERIALS
EQUIPMENT . . .



Titanium rivets . . .
are now available in a full range of sizes in production quantities. These rivets combine light weight with high strength and are designed to operate under extreme environmental conditions. Hi-Shear Rivet Tool Co., 2600 W. 247 St., Torrance, Calif.

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fabricates as easily as ordinary sheet metal, according to the manufacturer. Eliminates piece plating, even when parts require deep draws or severe bends. Apollo Metal Works, Dept. PEN, 6650 S. Oak Park Ave., Chicago 38, Ill.

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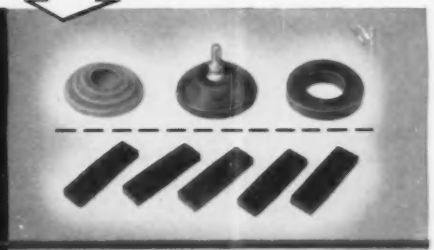
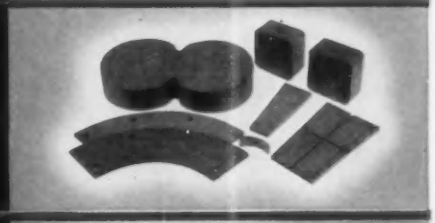
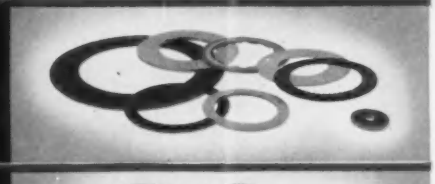


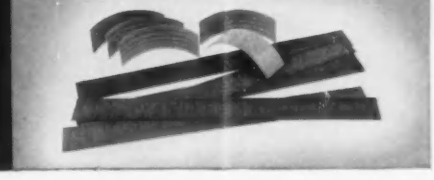
MOLDED FRICTION PARTS



SPECIAL CLUTCH FACINGS



TRANSMISSION LININGS



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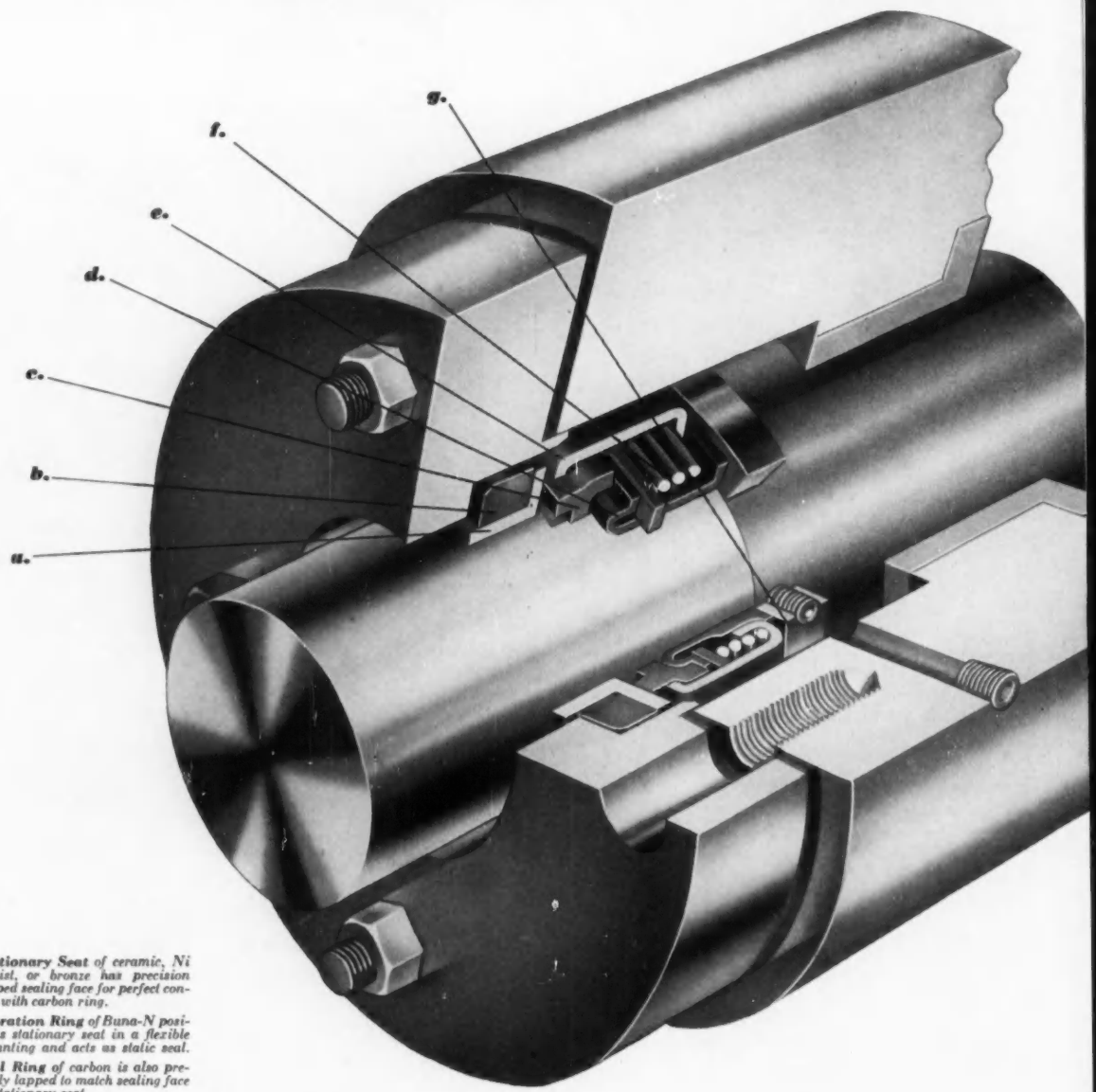

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c. ***Seal Ring*** *of carbon is also precisely lapped to match sealing face of stationary seat.*

d. ***Roll type Bellows*** *permits free movement of seal ring.*

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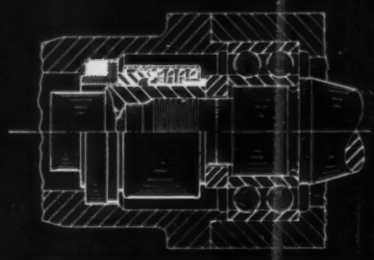
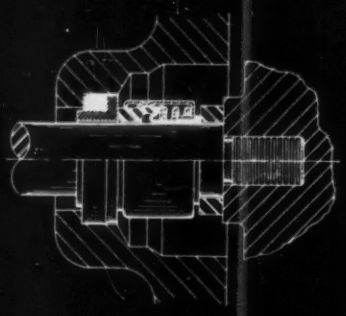
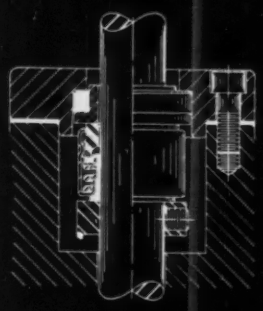


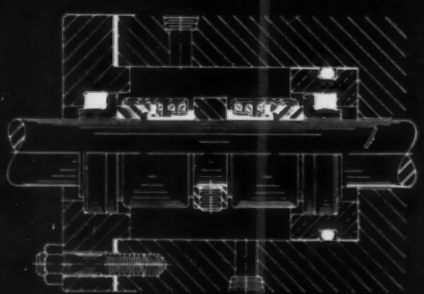
MECHANIPAK Package Seal installed on shaft for retaining lubricant in bearing.



MECHANIPAK Package Seal installed against impeller of centrifugal pump.



Package Seal installed on vertical pump shaft.



Double Package Seal installation on horizontal agitator shaft.

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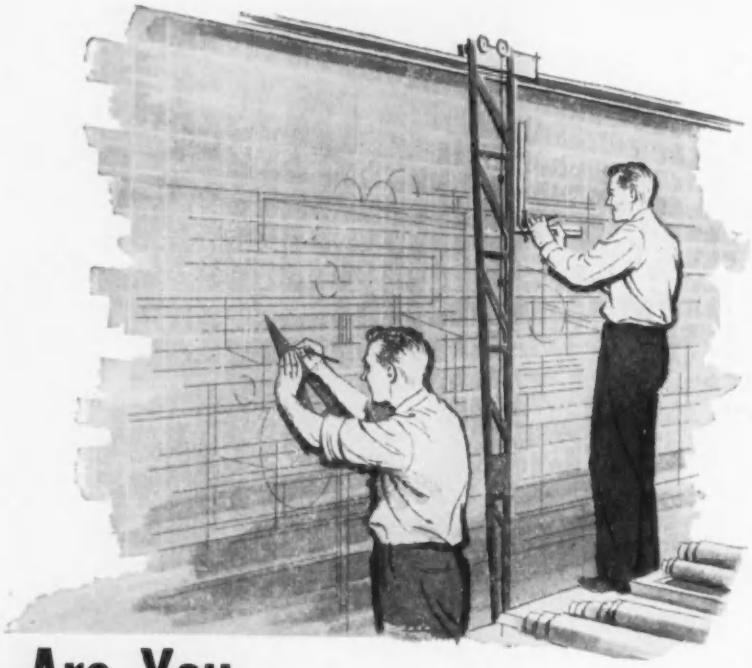

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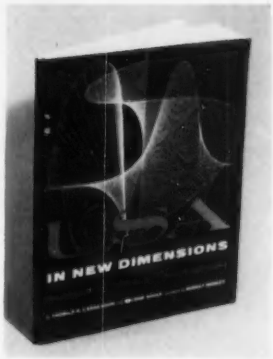

NEW LITERATURE

Survey of American Resources by Thomas R. Carskadon and George Soule for Twentieth Century Fund. Published by Macmillan Co., 60 Fifth Ave., New York, N.Y. 8⅜x10⅞ in., $1.50.

This study of the past, present and future potential of the American society and economy asks the questions: "Are old theories and classic economic concepts still valid? Or have we, perhaps, achieved half unconsciously a subtle transformation of the economy?" The authors do not fail to mention some of the problems and weaknesses still confronting our nation, but perhaps they fail to analyze fully enough the influences and limitations these factors will have on the future.

That this future will achieve new levels of spiritual and material well-being is evident, on the basis of this Twentieth Century Fund study, and the facts and figures developed and interpreted here should be valuable in determining the size, makeup and buying power of tomorrow's markets.

By 1960, according to the Fund's analysis, population should increase 16% over 1950 to 177 million. Purchasing power of this greater body of Americans should be nearly one-fourth larger than in 1950.

Housing these families by American standards would require a 10-yr expenditure of $146 billion, any sizable portion of which can constitute a resourceful long-term market. By 1960, Americans are expected to spend some $35.5 billion more to furnish and equip their homes, both old and new. Expanding and replacing the facilities required to produce all these goods requires an annual expenditure of about $45 billion, measured in 1950 dollars, an interesting figure for reference when reading the yearly forecasts of capital expenditures planned by American industry.

There are no automatic guarantees against hard times or recessions, as the authors point out, and poverty, slums and wasteful use of many of our resources is still a problem. However, they state that to bring all Americans up to a minimum, adequate living standard and to meet all our needs for industrial capacity, conservation and government services, we would need to produce by 1960 only 7% more than we probably will, in the light of present trends. J. K.

Testing with Eddy Currents

Abstracted from "Testing Metals 'On-the-Fly' with Eddy Currents," by Richard Hochschild, Control Engineering, Aug. '57.

Eddy current testing is proving applicable to automatic, continuous inspection (for either defects or variation from desired thickness or density). It can also provide a basis for checking, and sometimes measuring, metallurgical and chemical properties, such as strength and composition. Opportunity exists for circuits that would also embrace feedback quality control of the process involved.

Machine Control by Voice

Abstracted from "Voice-Actuated Machines; Problems and Possibilities," by E. E. David, Jr., Bell Laboratories Record, Aug. 1957.

Modern phoneticians have been able to apply analytical techniques and equipment developed by physicists and communications engineers to establish meaning-measurement relations for some of the distinct sound units (or "phones") that make up our speech. Actual three-dimensional models of some words have been created, demonstrating the principal parameters of these methods of speech analysis: frequency, time, intensity.

In a voice-actuated machine control, electronic circuits would measure incoming signals caused by the breakdown of commands into their component sounds. These would be compared with predetermined values based on the range of sound reorganization units built into the control.

Redundancy of speech and our use of inflection and emphasis to transmit information orally are among problems still to be solved.

A voice-actuated machine, called Audrey (for automatic digit recognizer), has been built, which can distinguish the 10 spoken decimal digits. These numbers are first analyzed by Audrey's circuits and then compared with her stored patterns. The machine actuates a light to indicate which digit is selected. A recent modification of Audrey gives understandable reproductions of some words. Progress towards preservation of voice quality is also being made.

Another machine, known as the "Vocoder," uses a compression system to handle speech signals. Voice-actuated machines applied to data processing, communications and automatic control are characterized as definite future possibilities.

SINTERED METAL PARTS—Booklet, 12 pp. Describes advantages of metal powder parts; how they are made; and the principles of economical design and production which should be considered. Typical characteristics of available alloys are given. Dixon Sintalloy, Inc., 535 Hope St., Stamford, Conn.

ENGINEERING & MANUFACTURING SERVICE—Brochure, 8 pp. Explains this firm's six basic divisions of mechanical engineering, tool engineering, laboratory, technical writing, special products division and the manufacturing plant. Write for a copy on your firm's letterhead. Associated Engineers, Inc., 446 Silver St., Agawam, Mass.

NON-WOVEN FABRICS—Booklet, 15 pp. Describes how fibers of Nylon, Orlon, Dacron and other synthetic fibers are made into continuous sheets of various thicknesses. Typical properties are given and actual samples are included. E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del.

SELECTING AN ENGINEERING FIRM—Brochure, 7 pp. Discusses three basic questions: 1) Do we need an engineering firm; 2) Whom should we choose; 3) what results can we expect? Teller Co., Butler, Penn.

SUPER-STRENGTH STRUCTURAL STEELS—Booklet, 20 pp. Describes characteristics and uses of steels possessing minimum yield strengths from 55,000 to 150,000 psi. Contains technical information and numerous tables describing composition, mechanical properties, heat treatment, corrosion resistance, machinability, size limitations and end uses of 15 grades. Climax Molybdenum Co., 500 Fifth Ave., New York 36, N. Y.

IMPROVING YOUR ENGINEERING AND R&D—Booklet, 11 pp. Discusses the creative role of the engineer, the benefits of work planning, and three major types of department organization. Wallace Clark & Co., Inc., 521 Fifth Ave., New York 17, N. Y.

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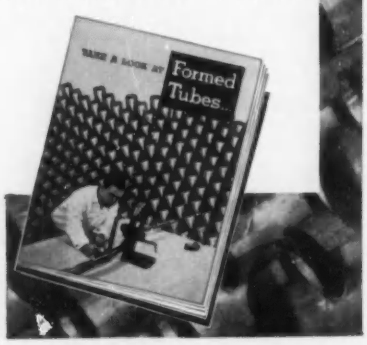

Publisher's Postscript...

To save you time . . .

At a staff meeting last week, we pointed out to members of our greatly enlarged editorial staff that September, 1957, really marks the 28th anniversary of this publication. For it was in September, 1929, that *Product Engineering* first saw the light of day—as one of the weekly issues of *American Machinist*.

During the late 20's, the design function in engineering departments of metalworking companies was becoming recognized as a separate operation and soon more and more manufacturers established separate design-engineering divisions. The magazine and these new divisions grew together, until today product design and product planning are the major influences spearheading American industrial growth.

Just as our many field contacts in the late 20's showed this separation of design engineering from the general engineering activity, so we have watched, in the last few years, the steady trend to separate research, product-planning and development departments in a great many companies. For now, more than ever, company growth depends on better products to sell—products incorporating the latest engineering and scientific achievements.

But to keep informed about late developments takes time—and time is the engineer's most valuable asset. Readers have told us about the many publications they must study, or at least scan, to get the facts they need. One well-informed product engineer said, "Why can't you give us the information we need in one paper and save the hunting and constant searching?"

Well, here it is.

Product Engineering has broadened its editorial scope and almost doubled its editorial staff. Twenty-seven full-time editors, with a staff of assistants, plus the facilities of McGraw-Hill's domestic and foreign news bureaus, all staffed by full-time editors, extend the reach of your eyes and ears.

And you are the silent companion of every editor who visits a project, a society meeting, or a Secretary of Defense. You look into the view-finder of every editor's camera, and you see with the perspective of trained, informed engineers like yourself.

Best of all, what you see can be used. Today's research will be in your development plans tomorrow (if you've read about it) and soon you will be on the road toward a new or improved product. —A. H.

7.4.0. (personal)

Recorders on a Budget

Want a tape recorder with a double-track, three-speed tape deck, a built-in sound mixer, a self-contained radio set, a monitoring system, and Hi-Fi reproduction system with three speakers?

Or could your needs be met by a little unit that will attach to a phonograph turntable to record everyday sounds and messages?

You can have either at surprisingly low cost.

For about $105, plus shipping charges (weight is 48 lb) and taxes, you'll be able to get an export model of the new British Winston Thoroughbred recorder (ready early next year) to do all the jobs listed above. You'll even be able to use it for office dictation, according to the manufacturer, Winston Electronics, Ltd., of Shepperton, Middlesex, England.

And $14.95 is all that's needed for a little Home Voice Recorder, complete with carrying case and three blank records. It was orginally designed as a toy but the marketing agent, Johnson Smith & Co., Detroit, says it's adequate for most voice-recording purposes. It works at any of the three standard speeds and operates independently of the phonograph circuit.

How do they do it at these prices? The American unit is, of course, a stripped-down model; but the British unit is not. Lower production costs, and costwise design, seem to be the answer.

Anyway, It'll Keep Golfers Honest

Golfer's scorekeeper looks like a wrist watch, but has counters instead of the usual clock face. Miles Kimball Company (Oshkosh, Wis.) sells it, says it will register strokes and total them for each hole. The deluxe model, priced at $4.95, also accumulates the total game score. Standard model is $3.50.

With all the instruments now available in wrist watch form (radios, timers, and the like), why not a Wristometer for the tired engineer—a wrist "pedometer" that would show him how many miles his hands have traveled back and forth across his drawing board—and, incidentally, give him a quick check on measured distances? (For real flashes of inspiration on products-of-the-future, see next page.)

Whisk that Whisker

Closer shaves, even in the tough spots, are promised by the Shick Powershave, now being introduced. It features a newly developed motor, said to be the most powerful of its kind ever built. Other features: a new "full-contact" head, with increased shaving surface; and "built-in whisker guides." Shick terms it a "radically new model," plans to retail it at $29.95.

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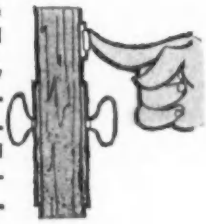
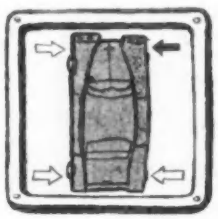
WHY DON'T THEY RESEARCH & DEVELOP

. . . a windshield wiper that really works. Aircraft companies are experimenting with hot exhaust gases blown across the glass—but that would be a dangerous method with open auto windows. A high-speed jet blast of warm air might work—or maybe a form of electrolysis to split water into hydrogen and oxygen on contact with electrically charged glass.



. . . a keyless lock to eliminate the dozen assorted keys we all carry and, on painful occasions, lose. It must be settable to recognize up to 10 people, by fingerprint or some other personal identification. It should not require memorizing codes or combinations. Recognition simply releases a latch and the bolt would be drawn by turning a knob or depressing a touch plate. Fingerprint identification may be too complex for any simple pickup mechanism within reasonable cost, but some positive identifier of this general nature would have so many commercial possibilities the necessary research would be paid for a hundred times over.



. . . a simple proximity device sensitive to the approach of solid objects. Pickups would be placed on the four fenders of a car and a small plan view on the dashboard would light appropriately placed arrows when triggered. Parking problems and garaging of automobiles would be vastly simplified if the driver didn't have to rely on his depth of vision for clearances under eight inches. Cost and simplicity would be the critical factors.

Have you a pet project but neither the time nor inclination to do the necessary R & D? Product Engineering will welcome (and identify the originator of) similar ideas based on known scientific principles but lacking an inspired manufacturer.

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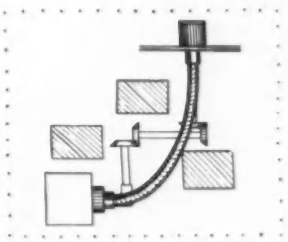

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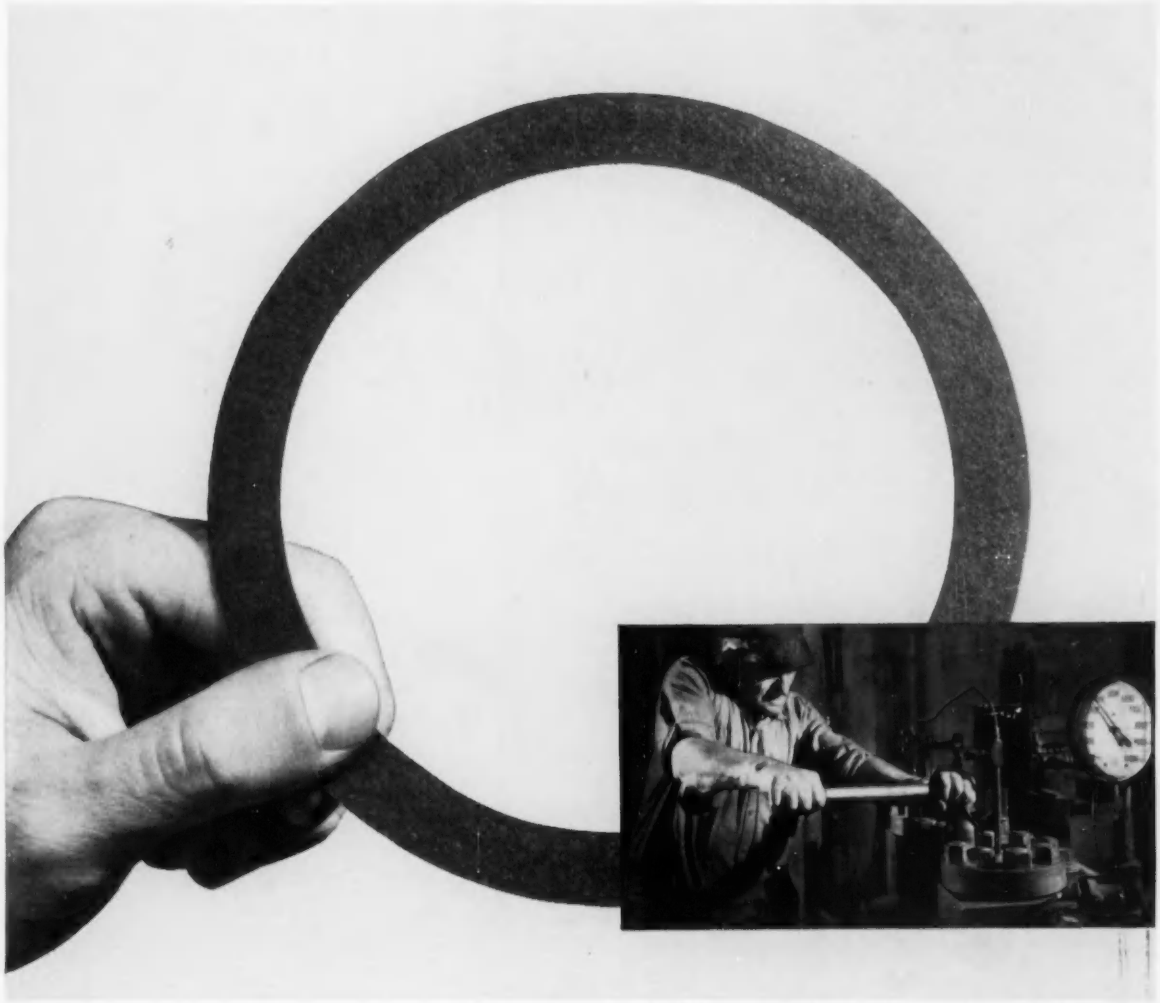

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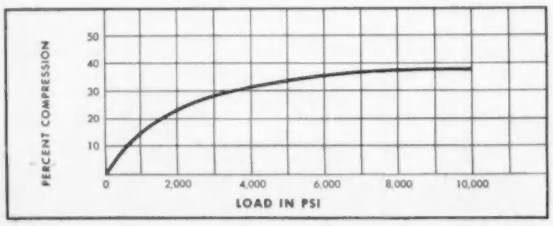

N-820 is made by a patented Armstrong process in which cellulose fibers are beater-saturated with a non-volatile, non-extractable latex binder. The result is a dense, crush-resistant material which has excellent torque-retention characteristics.

For more information on N-820 Accopac, write Armstrong Cork Company, 7009 Irvin Street, Lancaster, Penna.

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